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"THE GREEK QUESTION."*

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THE question whether the college faculty ought to continue to insist on a limited study of the ancient Greek language, as an essential prerequisite of receiving the A. B. degree, has been under consideration at Cambridge for a long time; and, since the opinions of those with whom I naturally sympathize have been so greatly misrepresented in the desultory discussion which has followed Mr. Adams's Phi Beta Kappa oration, I am glad of the opportunity to say a few words on the "Greek question."

This question is by no means a new one. For the last ten years it has been under discussion at most, if not at all, of the great universities of the world; and, among others, the University of Berlin, which stands in the very front rank, has already conceded to what we may call the new culture all that can reasonably be asked.

Let me begin by asserting that the responsible advocates of an expansion of the old academic system do not wish in the least degree to diminish the study of the Greek language, the Greek literature, or the Greek art. On the contrary, they wish to encourage such studies by every legitimate means. For myself I believe that the old classical culture is the best culture yet known for the literary professions; and among the literary professions I include both law and divinity. Fifty years ago I should have said that it was the only culture worthy of the recognition of a university. But we live in the present, not in the past, and a half-century has wholly changed the relations of human

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knowledge. Regard the change with favor or disfavor, as you please, the fact remains that the natural sciences have become the chief factors of our modern civilization; and—which is the important point in this connection—they have given rise to new professions which more and more every year are opening occupations to our educated men. The professions of the chemist, of the mining engineer, and of the electrician, which have entirely grown up during the lifetime of many here present, are just as "learned" as the older professions, and are recognized as such by every university. Moreover, the old profession of medicine, which, when, as formerly, wholly ruled by authority or traditions, might have been classed with the literary professions, has come to rest on a purely scientific basis.

In a word, the distinction between the literary and the scientific professions has become definite and wide, and can no longer be ignored in our systems of education. Now, while they would accord to their classical associates the right to decide what is the best culture for a literary calling, the scientific experts claim an equal right to decide what is the best culture for a scientific calling. Ever since the revival of Greek learning in Europe the literary scholars have been working out an admirable system of education. In this system most of us have been trained. I would pay it all honor, and I would here bear my testimony to the acknowledged facts that in no departments of our own university have the methods of teaching been so much improved during the last few years as in the classical. I should resist as firmly as my classical colleagues any attempt to emasculate the well-tried methods of literary culture, and I have no sympathy whatever with the opinion that the study of the modern languages as polite accomplishments can in any degree take the place of the critical study of the great languages of antiquity. To compare German literature with the Greek, or, what is worse, French literature with the Latin, as means of culture, implies, as it seems to me, a forgetfulness of the true spirit of literary culture.

But literature and science are very different things, and "what is one man's meat may be another man's poison," and the scientific teachers claim the right to direct the training of their own men. It is not their aim to educate men to clothe thought in beautiful and suggestive language, to weave argument into correct and persuasive forms, or to kindle enthusiasm by eloquence. But it is their object to prepare men to unravel the mysteries of the universe, to probe the secrets of disease, to direct the forces of nature, and to develop the resources of this earth. These last aims may be less spiritual, lower on your arbitrary intellectual scale, if you please, than the first; but they are none the less legitimate aims which society demands of educated men: and all we claim is that the astronomers, the physicists, the chemists, the biologists, the physicians, and the engineers, who have shown that they are able to answer these demands of society,

should be intrusted with the training of those who are to follow them in the same work.

Now, such is the artificial condition of our schools, and so completely are they ruled by prescription, that, when we attempt to lay out a proper course of training for the scientific professions, we are met at the very outset by the Greek question. Greek is a requisition for admission to college, and the only schools in which a scientific training can be had do not teach Greek, and, what is more, can not be expected to teach it.

This brings us to the root of the whole difficulty with which the teachers of natural science have been contending, and which is the cause of the present movement. We can not obtain any proper scientific training from the classical schools, and the present requisitions for admission to college practically exclude students prepared at any others. At Cambridge we have vainly tried to secure some small measure of scientific training in the classical schools: first, by establishing summer courses in practical science especially designed for training teachers, and chiefly resorted to by such persons; and, secondly, by introducing some science requisitions into the admission examinations. But the attempt has been an utter failure. The science requisitions have been simply "crammed," and the result has been worse than useless; because, instead of securing any training in the methods of science, it has in most cases given a distaste for the whole subject. True science-teaching is so utterly foreign to all their methods that the requisitions have merely hampered the classical schools, and the sooner they are abandoned the better. Both the methods and the spirit of literary and scientific culture are so completely at variance that we can not expect them to be successfully united in the same preparatory school.

We look, therefore, to entirely different schools for the two kinds of preparation for the university which modern society demands—schools which, for the want of better distinctive names, we may call classical and scientific schools. In the classical school the aim should be, as it has always been, literary culture, and the end should be that power of clothing thought in words which awakens thought. Of course, the results of natural science must to a certain extent be taught; for even literary men can not afford to be wholly ignorant of the great powers that move the world. But the natural sciences should be studied as useful knowledge, not as a discipline, and such teaching should not be permitted in the least degree to interfere with the serious business of the place. In the scientific school, on the other hand, while language must be taught, it should be taught as a means, not as an end. The educated man of science must command at least French and German—and for the present a limited amount of Latin—as well as his mother-tongue, because science is cosmopolitan. But these languages should be acquired as tools, and studied no further than they

are essential to the one great end in view, that knowledge which is the essential condition of the power of observing, interpreting, and ruling natural phenomena.

In such a course as this it is obvious that the study of Greek would have no place, even if there were time to devote to it, and we can not alter the appointed span of human life, even out of respect to this most honored and worthy representative of the highest literary culture. Of course, no one will question that the scholar who can command both the literary and the scientific culture will be thereby so much the stronger and more useful man; and certainly let us give every opportunity to the "double firsts" to cultivate all their abilities, and so the more efficiently to benefit the world. But such powers are rare, and the great body of the scientific professions must be made up of men who can only do well the special class of work in which they have been trained; and, if you make certain formal and arbitrary requisitions, like a small amount of Greek, obstacles in the way of their advancement, or of that social recognition to which they feel themselves entitled as educated men, those requisitions must necessarily be slighted, and your policy will give rise to that cry of "fetich" of which recently we have heard so much.

Now, all the schools which prepare students for Harvard College are classical schools. We do not wish to alter these schools in any respect, unless to make them more thorough in their special work. As I have already said, the small amount of study of natural science which we have forced upon them has proved to be a wretched failure, and the sooner this hindrance is got out of their way the better. We do not wish to alter the studies of such schools as the Boston and Roxbury Latin Schools, the Exeter and Andover Academies, the St. Paul's and the St. Mark's Schools, and the other great feeders of the college. No—not in the least degree! We do not ask for any change which in our opinion will diminish the number of those coming to the college with a classical preparation by a single man. We look for our scientific recruits to wholly different and entirely new sources. For, although we think that there are many students now coming to us through the classical schools who would run a better chance of becoming useful men if they were trained from the beginning in a different way, yet such is the social prestige of the old classical schools and of the old classical culture that, whatever new relations might be established, the class of students which alone we now have would, I am confident, all continue to come through the old channels.

This is not a mere opinion; for only a very few men avail themselves of the limited option which we now permit at the entrance examinations—nine, at least, out of ten, offering what is called maximum in classics.

We look, then, for no change in the classical schools. Our only

expectation is to affiliate the college with a wholly different class of schools, which will send us a wholly different class of students, with wholly different aims, and trained according to a wholly different method. At the outset we shall look to the best of our New England high-schools for a limited supply of scientific students, and hope by constant pressure to improve the methods of teaching in these schools, as our literary colleagues have within ten years vastly improved the methods in the classical schools. In time we hope to bring about the establishment of special academies which will do for science-culture what Exeter and St. Paul's are doing for classical culture. We expect to establish a set of requisitions just as difficult as the classical requisitions—only they will be requisitions which have a different motive, a different spirit, and a different aim; and all we ask is, that they should be regarded as the equivalents of the classical requisitions so far as college standing is concerned. We do not at once expect to draw many students through these new channels. To improve methods of teaching and build up new schools is a work of years. But we have the greatest confidence that in time we shall thus be able to increase very greatly both the clientage and the usefulness of the university.

Is this heresy? Is this revolution? Is it not rather the scientific method seeking to work out the best results in education as elsewhere by careful observation and cautious experimenting, unterrified by authority or superstition? Certainly, the philologist must respect our method; for of all the conquests of natural science none is more remarkable than its conquest of the philologists themselves. They have adopted the scientific methods as well as the scientific spirit of investigation; but, while thus widening and classifying their knowledge, they have rendered the critical study of language more abstruse and more difficult; and this is the chief reason why the time of preparation for our college has been so greatly extended during the last twenty-five years. Nominally, the classical schools cover no more ground than formerly, but they cultivate that ground in a vastly more thorough and scientific way.

These increased requirements of modern literary culture suggest another consideration, which we can barely mention on this occasion. How long will the condition of our new country permit its youths to remain in pupilage until the age of twenty-three or twenty-four; on an average at least three years later than in any of the older countries of the civilized world? It is all very well that every educated man should have a certain acquaintance with what have been called the "humanities." But when your system comes to its present results, and demands of the physician, the chemist, and the engineer—whose birthright is a certain social status, which by accident you temporarily control—that he shall pass fully four years of the training period of his life upon technicalities, which, however important to a literary

man, are worthless in his future calling, is it not plain that your conservatism has become an artificial barrier which the progress of society must sooner or later sweep away? Is it not the part of wisdom, however much pain it may cost, to sacrifice your traditional preferences gracefully when you can direct the impending change, and not to wait until the rush of the stream can not be controlled?

INFLUENCE OF THE ENVIRONMENT ON RELIGION.

By Professor JAMES T. BIXBY.

WHILE religious phenomena are in some respects singularly constant, they are, nevertheless, as noted for their diversity. While certain essential elements are common to almost all faiths, on the other hand, every individual faith has something peculiar to itself. It not only differs in some respects from other religions, but, as we trace down its history, we find it varying from itself.

The Hindoos, Persians, Greeks, Romans, Kelts, Teutons, and Slavs, are shown by philological research to have come originally from a single stock—the primitive Aryan. Their ancestors originally dwelt together in a common home in the neighborhood of the Caspian Sea; and in this ancient time their religion was, probably, one and the same faith, i. e., in substance. Yet how widely diverse have the faiths of these nations come to be, in the four to five thousand years since that ancient home was little by little deserted! How has this diversity come about? What are the forces or influences that differentiate religions? We may divide them roughly into two kinds: 1. The external variables. 2. The internal variables. In this paper I shall try to sketch the first; i. e., those environing influences about man, about a special race or nation, that tend to produce variation in the course of the development of religion.

1. I would mention the varied influences of outward nature. The diverse phenomena of the world naturally diversify the direction and character of faith. The religious capacities common to all men evolve a stock of religious feeling which lies latent and fluent, as it were, in the soul—like an electric charge in the battery—until some expeperience of the man occurs to elicit its discharge and give it direction. The form and path of faith are determined, in much, by the kind of natural objects with which the spiritual faculty is most closely or impressively brought in contact. Where the spirit of man is frequently confronted with Nature in its power, beauty, or wrath—where sky, sun, mountain, or river, is an important factor in the daily experience and fortune—there arise naturally the corresponding forms of religion—Nature-worship, fetichism, and pantheism. Where, how-

ever, it is dreaded and mysterious *animate* things—the gloomy, awe-inspiring forest, the venomous serpent, the terrible lion—that most agitate man's heart, there we see, as in Africa, e. g., and among the American aborigines, tree-worship and beast-worship abounding.

There are certain great natural phenomena that are common to all countries, familiar with all tribes and nations, such as sun, moon, stars, earth, rain, wind, etc. These are, therefore, the objects universally divinized. In some countries, where the scenery is very slightly diversified, these few objects, personified over and over again, in varied aspects and under various symbols, seem to constitute the whole pantheon, the whole mythology. It was thus in Egypt, e. g., whose numberless gods represent, after all, but about half a dozen great natural objects. But when we pass out of the level plains of such countries as Egypt and Babylon, to countries where the mountains rise to stupendous and frowning heights, and bowlders and cliffs abound, we have a new class of divinities added to the objects that man worships. The mountaineer, gazing aloft to the white peak, saw, far up, the shining morn strike the cheek of virgin snow, and in his guileless faith it became an abode of the gods; or a deity itself, holding aloft the heavenly dome. If on the soft sandstone of a hill, before petrifaction, bird or beast had left its tracks, then the place, like the Enchanted Mountain of Georgia, was deemed haunted. If the mount, like Kineo, in the north of Maine, happens to have the shape of a moose, then it is reputed to be the queen and progenitor of the moose-tribe turned to stone.

When the barbarian cries out in joy or pain beneath the rocky wall, he hears a mysterious voice answering him back—a voice that belongs to no material creature, and that must, therefore, belong to some divinity or departed spirit. So the sounds that come from caverns, or the roar of the billows on the sea-shore, are thought to be produced by the spirits that have their haunt there; and the kobolds and water-nixies are accordingly added to the lists of the gods popularly believed in. The strange phenomena of volcanoes, or the explosion of confined gases in certain rocks, in their ebullition through springs, would suggest the idea of mighty superhuman beings who lived beneath the earth, and to whose activity the volcano's eruptions were due. The Koniagas think that, when the craters of Alaska send forth fire and smoke, the gods are cooking their food and heating their sweat-houses. So among the Australians, the volcanic rocks found in various places suggest the belief that sulky demons, the *igna*, have made great fires and thrown out red-hot stones; and the Nicaraguans offered vessels of food and even human victims to Popogatipec, i. e., smoking mountain, to appease her when there was a storm or an earthquake.

Wave and frost are great sculptors of rude images, bearing near enough likeness to man or beast to impress profoundly the imagina-

tion of the uncultivated. All along our Northern coasts and in our Western mountains are to be found such figures—like the Stone-face, at the White Mountains; the Bishop Rock, at Campobello, on the Maine coast; and the Master of Life, at the entrance to Lake Superior. So in the North and West of our country there are many erratic bowlders, some oval, or glistening with native copper or mica scales, or balanced on convex prominences so that they readily oscillate. In unenlightened but pious minds, such curious figures naturally inspire veneration and worship as the abodes of spirits, as was the case with the Ojibways, Ottawas, and Dakotas; or they give rise to wild myths of transformation, such as the Indian legends abound in. So, where the rocky and mountainous aspect of nature produces cataracts or dangerous rapids, and the waters roar and toss their white manes in the air, these places—as, e. g., Niagara, the mouth of the Wabash, or the Brear Beaux Falls on the Wisconsin—became to the savage the haunt of spirits or demons, who must be propitiated with offerings of tobacco and meat.

And this mention of tobacco may serve to turn our thoughts to remembrance of the influence of trees and plants in drawing forth religious veneration. Wherever plants are found, like tobacco, or the Peruvian coca, the snake-root, the Indian hemp, the wine of Bacchanal worship, that had a special effect; whether stimulating, narcotic, poisonous, or curative, they were held to possess supernatural power, and were used for various magic rites and became sacred. The *soma* of the ancient Aryans even became exalted to a place among the gods, and to drink it was the means of gaining immortality. So, likewise, the mysterious whisperings of the wind in ancient forests, or the inexplicable movements of some half-blown-down tree, as the heat of the sun contracted or lengthened its twisted roots, and caused it alternately to rise and fall, have more than once attracted the superstitious awe of the barbarian, and supplied new objects for his adoration.

Thus do the peculiarities of natural objects supply molds in which the metal of religious faith, already lying latent, readily sets. And not only directly, but indirectly, do they shape the forms of faith. The rushing river, e. g., not merely attracts the reverence of the primitive man to itself, but by its swift and treacherous motion, its sinuous course, and snake-like hiss and gleam, it is personified as a mighty divine serpent, and next makes sacred by association the serpents of the country about. The sky, personified by the ancient Egyptian as a heavenly goose, enveloping and hatching the cosmic egg, made sacred henceforth all geese to the pious dwellers by the Nile. In climes like Egypt, where the skies are rainless and the whole aspect of nature equable, almost unchanging, there the gods are marked by calmness of bearing and serenity of nature. We must go to the slopes of the Himalayas or the ridges of the Apennines to find the howling Rudra, with his attendant Maruts, the pounders, rushing wildly through the

glens, or to see the bullocks slain in honor of Jupiter Tonans, the Thunderer. In cold and temperate climes it is the enlivening and warming sun that is loved and adored; but, in the sultry air of the tropics, the sun and the sky of day become evil and destructive deities, and affection is transferred to the refreshing sky of night.

So, also, in their ideas of heaven and hell, there is a natural contrast between the faith of the man of the tropics and the man of the Arctic zone. To the first, the future home of the good is some abode of coolness, some garden of the Hesperides, or a breezy Olympian height, and the place of punishment a place of fire. To the Icelander, hell is the place of cold, worse far to him than fire, and heaven, some comfortable hall surrounded by a hedge of flame. Again, in hot climes, where the soil of the river-bottoms is deep and rich, and nature teems with productiveness, there the gods are credited with the same sensuous nature; religious ideas are apt to revolve about the mysteries of procreation, and the worship of the people is apt to include not a few impure rites and symbols.

The numerous gods of fertility among the agricultural Egyptians —Chem, Min, Chnam, Osiris—the sexual rites of Babylonia, and the numerous objectional symbols in Hindoo worship, illustrate this. On the contrary, under the clear skies and bright moon and the pure streamlets of Greece, it is the virgin goddesses of the most exacting purity, Dianas and Pallas Athenes, rather than loose-zoned and wanton mistresses, that are suggested. Aphrodite and Cybele, and Dionysos indeed, were, later, members of the Olympian court; but they came from regions farther east, where they were tinged with an earthly and sensuous dye, such as we do not find in the native worship of Hellas.

The tribes of Northern Asia, wandering amid the bleak wastes of Mongolia or the gloomy forests of the Ural, their frail shelter shaken by the riotous winds, whose mysterious sighs and howlings often make them quake with terror, come naturally to be believers in dim, mysterious, supernatural powers, with which their own lot is bound up, and readily devote themselves to whatever occult and magic rites the shaman may produce. The Shemite, on the broad plains of Chaldea or the sandy wastes of Arabia, found nothing to arrest his eyes till they rested on the glistening skies, brilliant, in that clear air, with a brilliancy beyond anything that we know: and he became thus, most naturally, a devout star-worshiper; invested the chief celestial objects with the most exalted attributes, and raised them, in his fervid adoration, to more and more absolute majesty and incomparable power, till at length the idea of the divine was exalted into monotheism.

The Aryan, on the contrary, grew up among the mountain pastures of Bactria, where the clouds are often about his feet, and the heavens are not so far away. The earliest Vedic hymns are marked by a sense of the nearness of the gods, and men are seen mingling with them, familiarly, as friends. Nature did not oppress man with dreadful

earthquake or hurricane, vast and fatal desert, or frowning mountain; but by its pleasing diversity it stimulated, without overwhelming, his soul. That portion of the Aryans that, upon their migration from the old Bactrian home, reached the shores of the Ægean, found there a land that fostered still more these traits. Here nature was picturesque and diversified, without the stupendous magnitudes that overawe the soul. Above him, the sky was bluest of the blue. The marble hills formed continual pictures. The streams rippled cheerily down their songful beds. The wavelets chased each other playfully in the light zephyrs. All the aspects of earth and sea and sky were bright and gladsome, and conspired to stimulate the imagination of the Greek.

Hellenic religion came thus, by right, to be a happy and luxuriant faith, full of pretty fancies, putting man at ease with the divine, and personifying the gods under the most familiar and graceful shapes:

> "Sunbeams upon distant hill,
> Gliding apace with shadows in their train,
> Might, with small help from fancy, be transformed
> Into fleet oreads, sporting visibly."

The wind was fancied a divine harper, who makes music in the tree-tops, and drives the flocks of the sun—the fleecy clouds—where he wills. The murmuring spring was imaged as a gentle nymph; and within each fine tree was an imprisoned dryad. In short, the diversified and charming scenery supplied an unequaled wealth of religious and mythic lore. And, as man, in this climate, exempt from the debilitating heats of the tropics and the stunting of too severe cold, reached the ideal of bodily perfection, the human form became, not unnaturally, to the Greek, the noblest type under which he could represent the divine. The gods were humanized—stronger and more beautiful beings, to be sure, than ordinary men, but possessed of the same forms, members, and passions.

The course which the Norsemen took when they, in their turn, went forth from the common Aryan home, was less propitious. It led them to a land where the summer was short and the sun soon had to wage a bitter and losing war for long months with frost and snow; a land where the fiords were heavily sealed with ice, and man had a bitter task to keep the wolf of starvation and death from his door. The sternness and gloom of the land were reflected in the Northman's thought and faith. Woden, the stormful, Thor, the thunderer, and Loki, the vengeful and cunning destroyer, become the chief figures in his myths. The interest centers in the struggles of the Aesir, the deities of light and beneficence, against the frost-giants and their allies or servants—the midgard-serpent, the fenris-wolf, and the dreaded Hel—varied personifications of darkness, cold, and death.

Delighting himself, as the Norseman did, in the vigorous exercise and the hearty feasting, to which the frosty air stimulated, his gods

likewise were boisterous and stalwart beings, riding on the tempest, amusing themselves by feats of strength, reveling in the crash of battle, and gathering the fallen heroes into the bright Valhalla, there to reward them for their courage with foaming cups of mead, and the barbaric delights of ceaseless combats, in indestructible bodies. Thus, instead of the Graces and the beautiful Apollo of Greece, we find in Scandinavia deities as blustering and uncouth as the Northland itself, but manly and good-hearted. While in Greece the primitive Aryan faith takes on a more æsthetic and refined aspect, in Germany and Scandinavia it becomes more tragic and intense.

Let us follow next the steps of that part of the Aryans who turned their steps southward into the languorous plains of India, and we shall see a different change. The first thing we notice is, that Dyans—the shining one, the bright sky of day—loses his ancient pre-eminence. His supremacy in the thoughts of the Aryan emigrants is first taken by Varuna—the night-sky. In the hot clime of India, the bright sky of day was no longer so pleasant to them, and Varuna seemed a kinder deity, and therefore became more popular. But soon he also is superseded by Indra, the rain-god, who, with his glittering lance—the lightning—pierces and releases the imprisoned waters. For in India, then, as to-day, the coming of the rainy season after the long drought is by far the most important of all nature's changes. It was not long before Indra, therefore, by his terrible might and his beneficent prowess in slaying the drought-serpent, became, with his coadjutors, the Maruts, the beating winds, the chief object of Vedic adoration. And soon we notice an equally significant change. The vigorous Aryan, in the debilitating heats of the Indian plains, became a victim of lassitude. He lost his healthful delight in the good things of sense and earth. The languid air lulled him in dreamy reveries. Meditation takes the place of service in the commandments of religion; and asceticism, instead of the divine blessings, becomes the pious practice. So great and so rapid is the change that comes over their faith that, before many centuries have passed, pessimistic views of life become so seated in the race that the illusiveness of the world and the essential wretchedness of life become cardinal doctrines of faith; and the great desire of men's heart's is not for renewed lease of life, but for the means of obtaining exemption from the misery of *rebirth*. And so it has been with other nations and races. The physical characteristics of the countries they have dwelt in have powerfully modified the aspect of their religion. The races inhabiting the most barren and unfavorable quarters of the globe—such as the Patagonians, Hottentots, Kamschatkans—have suffered correspondingly in their possibility of religious progress. Conversely, it is that intermediate zone between the tropical and the temperate—the land of the olive, the fig, and the orange—where the mean temperature is not lower than 60° Fahr. nor more than 75° Fahr., that has been the home of the great founders of re-

ligions—Zoroaster, Moses, Buddha, Mohammed, Confucius, and Christ. Moreover, we may notice, as Peschel has pointed out, the suggestive fact that it is in the wide expanses and awe-inspiring solitudes of the desert, where the imagination, while vividly excited, is yet not distracted and divided among the manifold wonders of nature—shimmering leaf and gnarled trunks, writhing mists and rattling thunder, and the weird sounds of forest or sea-beach—that suggest and develop the polytheistic gods, but can give itself up entirely to the impressions of a single Majesty and Infinity—it is, I say, amid these noble yet simple aspects of nature, that the great monotheistic religions, Judaism, Mohammedanism, and Christianity, have been originated. It was at Sinai that Moses promulgated his stern prohibitions of idolatry and polytheism. It was by a Bedouin foster-mother that Mohammed was reared, and as a shepherd and caravan-merchant, traveling across the Arabian deserts, that he passed his early life. And it was in the desert that Christ listened to the preaching of John the Baptist, and passed the forty days in which he prepared himself for his great career.

2. In the second place, we must notice, as of equal if not greater influence in giving diversity to religious faith, man's experiences with himself and with his fellows. It is an old maxim that it is "in the experiences of life that each individual finds or loses his god." Starting on the lowest range of the soul's experience, we notice the effect of the dreams, trances, swoons, ecstasies, and other abnormal phenomena of human nature, in giving direction and variety to religious conceptions. While I regard it as a grave error to derive religion *solely* from these morbid phenomena, nevertheless they have undoubtedly done much in awakening the spiritual powers of man, and in giving shape to his religious instincts. Life, in its most familiar and natural phases, is a mysterious thing—a wonder which doubtless filled the primitive man with ill-understood awe, as it has made even the pride of modern science stand abashed before it. And its more eccentric and exceptional aspects would especially set men to marveling, and suggest explanations which we may to-day laugh at, but without really having penetrated into the heart of the mystery any more than our remotest ancestors. Thus, among almost all peoples the shadow has been looked upon as a second self, and as one of the causes if not the cause of life. The breath, likewise, with whose cessation life ends, has been especially identified with the soul, the principle of life, as is shown by the same or similar words employed in most languages, as their names—*atman* in Sanskrit; *nephesh* and *ruach* among the Hebrews; *wang* among the Australians; *anemos* and *anima* in Greek and Latin—indicate. As in dreams the savage seems to see his distant kinsmen, to visit remote localities, to behold again the long-dead parent or grandparent; so he comes to believe that the soul, an impalpable form within the fleshly organism, is capable of leaving the body when it pleases, of taking long journeys and flashing with incredible

swiftness from place to place, of possessing its will and consciousness independently of the body, and continuing to exist and appear after the death of the body.

This conception of the soul once formed, the abnormal facts of disease, insanity, epilepsy, and hysteria, come readily to be explained by the invasion into these bodies of other spirits than their own—celestial or demoniac, superhuman or infra-human, according to the phenomena observed. These notions, once diffused, give rise, in their turn, to a whole cycle of kindred animistic theories and religious practices—such as divination by dreams, exorcisms of demons, dervish-dancings, and other artificially produced swoons and ecstasies, and fetichistic magic of all sorts. Sneezing, hiccough, and all painful diseases, are to the savage the work of some spirit that has crept into his body. Fasting, as occasioning vivid visions, becomes a method of seeing one's tutelar deity, as among our Indians, or as the proper rite to fit the priest for initiation into his sacred office, as generally in savage tribes.

When it is evil spirits that do their work in man, they must be cast out by invoking some beneficent and more powerful god. Hence exorcism, witchcraft, medicine-men. When it is good spirits that do their work in man, we have inspired seers and priestesses—divine oracles, like those of Delphi and Dodona. Out of a belief that the spirits of the dead still maintain an interest in those they have left, and are causers of good and evil to them, come propitiation of them by gifts and prayers, and ancestor-worship—so prevalent in ancient China, Egypt, and Rome, as among many African and Polynesian tribes still—is developed.

Next, perhaps (as happens in many cases), the departed chieftain or patriarch, still looked upon as protecting his descendants and tribesmen, becomes the guardian deity of the tribe, or the ruler of the hidden land to which the ghosts of the dead must journey. As still further evolutions from this root, we find the belief in the resurrection of the body and the transmigration of souls, the custom of embalming, and the varied ideas of the nature of the future life found in different nations.

3. Next, we must notice the great influence of man's intercourse with his fellows. Under this third head I would call attention to the action of the political condition or environment, as a differentiating factor. In ancient times, the connection between religion and government was far closer than we see almost anywhere to-day. That separation between church and state, that independence of politics and faith so prevalent everywhere to-day, was unknown to antiquity. The state and the church were one. The king was high-priest by virtue of his office, and the priest as much a state or civic official as judge or warrior-chief. Not infrequently, the same individual held both what we now distinguish as secular and sacred offices. Among the ancient Aryans—as with the early Hindoos, Greeks, and Romans—religion

was a domestic rite. Each home had its altar and its sacred fire, whose flame must never be allowed to go out. And so the word *hestia* or *vesta*—the *fixed* place for the family hearth-fire—came to represent the divine mother, the guardian of the family, who, if duly honored, would preserve it in honor and prosperity. It was the office of the father or grandfather, the living head of the family, to pour on the sacred flame the offerings of meal and butter, to offer the incense and pour out the libations, and to salute with prayer and praise the beneficent god of light, at his morning rising; or when, by neglect properly to feed the deity of the hearth, the god had left them, it was the duty of the father to bring him back, by the friction of the sacred sticks.

As families increased to tribes, and tribes were consolidated, the chief of the tribe, the patriarch of the community became, of course, the proper officer to perform the religious rites for the greater social body; as was the case in ancient Egypt, Assyria, Greece, and Rome, and is still the case in China to-day. The gods were conceived of as belonging to and concerned only with the tribe or nation that worshiped them; often, indeed, were imagined inseparable from a particular land; and he who went away from it was beyond the protection of his accustomed gods.

Thus David, in his well-known appeal (1 Samuel, xxvi, 19), says to Saul, If men have stirred thee up against me, they are cursed, for they have driven me out this day from dwelling in Jehovah's heritage, saying to me, Go, serve other gods. The idea that *all* lands might be under the care of one god, and the people of different nations might be of one religion, was a conception slow in arising. Whoever belonged to a tribe or nation was bound to worship the gods of that nation. When a man was adopted into a nation, or a woman married into another *gens* or tribe, such a person was held to adopt the divinities and tutelar deities of their new companions also. The promise of Ruth to Naomi, "Thy people shall be my people, and thy God my God," was not an exceptional but a necessary conjunction. To disown or ignore the gods of one's fathers was to disown one's nationality.

Conversely, the god of a special people *must* protect and favor his own. In the historical books of the Old Testament, e. g., we see many times appearing the idea that Jehovah's honor is so bound up with that of his people that he could not neglect to protect and bless them, no matter how great his wrath against their trespasses. The existence of foreign gods was not at all disbelieved, nor their power denied. But they were looked upon as naturally confining their favors to their own land and people. It was proper that their own people should worship them, but to foreigners they would be indifferent or hostile. To introduce strange gods into the state was therefore a dangerous experiment, entailing the risk of alienating their rightful divine protectors.

Similarly, the idea of seeking proselytes to one's own religion was, at first, quite antagonistic to the instincts of faith. The favor of Brahma, the blessings of Jehovah, were *privileges* of the chosen people of these gods; especial boons, which were not to be rashly cheapened by admitting foreigners to them. The *sudra*, however, desirous of knowing and worshiping the Brahmanic deities, was never allowed to read the Veda, or join in the most holy ceremonies.

Now, from this local character of ancient divinities it is evident what greater influence political conditions would have on religion than is possible in our day, when state and church are so independent of each other. In races, like the Aryan, where the early organization was into small communities with a patriarchal or *quasi*-republican government, where both the diversified face of the land and their own free spirit kept a host of small cities and states in independent existence, there the loose coalescence which comes through commerce, and identity of speech and civilization into a national life and religion, does nothing to destroy the various local gods, and we have, as in India, Greece, and Germany, a bewildering pantheon of divinities, many most similar to one another, because originally representative of aspects of the *same natural* objects or phenomena. Their religion was as full of variety and as lacking in centralization as their political system.

The first result on religion of advance toward national unity is, therefore, a great multiplication of deities. But soon other forces are called into play. Wherever, by conquest, intermarriage of princes, or treaties of alliance, two or more small states are thoroughly merged into a larger, there a *coalescence* of their gods and *diminution* of the number of the divinities are apt to take place. While their fetich-gods—divinities of merely local origin, mountain, earth, tree, cavern, river—would be different, the elemental gods—deities of sun, moon, sky, wind, and storm—would be common to both, and have more or less common features. They would, therefore, be readily identified, and their worship, under a name and ritual compounded, very likely, from the traditions of both tribes, would gain in popularity, while the more local gods, worshiped only by parts of the new nation, would fall into oblivion.

Again, when an ancient nation was subjugated, it was not believed to be due merely to the weakness of the people, or their inferior courage or military skill; but the people's tutelar deities were supposed to have withdrawn their protection, or to have been shown inferior in their guardian power to the gods of the victorious people. The people often, therefore, *voluntarily* abandoned their own deities, to secure the more effective protectorship of the victorious gods. In the wake of the great armies of Assyria and Rome, faith after faith of antiquity was left a wreck of its former self, its sacred prestige ruined, and its gods degraded into subordinates of the triumphant foreign deities.

The conquerors sometimes relentlessly stamped out the worship of the conquered. Often, out of policy or pity, they gave it a *quasi*-recognition; and then came about an amalgamation of beliefs.

These international religions tended to subdue the ethnic distinctions and local worships, and to give prominence to the higher and more universal deities. Thus, the great monarchies of antiquity, through their very tyranny and the absoluteness of the royal power in them, broke the path for the universal religions. The Roman Empire was the forerunner that made straight the way for Christianity. Sargon of Assyria is no more famous for his conquests than for his systematization of the Mesopotamian religion. And in Egypt we find its *religion* unified step by step with the *government*. The rival cycles of gods and goddesses, the varied triads of its different epochs, the confusing medley of divinities, great and small, of whom, now one, now another, is said to be the supreme, can never be comprehended until we recognize that the *political unity* of Egypt was not *original* or constant, but a growth, through the consolidation of the forty-two distinct *nomes* or districts which occupied the length of the valley.

Each of these little kingdoms, or duchies, as we may call them (resembling, in their relations to one another, the little duchies of Germany before Prussia swallowed them up so effectually), had its capital, its hereditary duke, its special deity or deities, and its shrine or great temple. We find the names of the Egyptian gods followed by the name of their special home, as Neith of Sais; Amân-Ra, chief in Aptu, i. e., Thebes. When gods of the same name or origin were worshiped in different places, they were regarded as more or less different deities, and often had different characteristics or symbols.

Thus we find four Sets mentioned in one inscription and six Anubises in another. Though originating from the same natural object, different aspects of the divine power were deified in each. When at length these independent districts were united in a single empire and a close social unity, the deities were naturally consolidated more or less.

Out of political comity and national sympathy, the people of each nome would admit the deities of other sections as also venerable and worshipful; but, in their own grading of the comparative dignity of the various gods, each would put its own local deities in the chief seats, and make the deities of other districts subordinate to them. Hence would arise distinctions among the gods, as, some of the first order, others of the second, others of the third. Those that in one nome, say, that of Thebes, were placed at the head, in another, such as that of Memphis, always jealous of its rival for the dignity of the metropolitanship of Egypt, would be likely to be put down into the second or third class, to make room for the ancient hereditary favorites of the worshipers of that locality.

As, in the political struggles of the country, one nome after another

became the seat of the central government—now This, now Thebes, now Memphis, now Tanais—or as the royal house (through some dynastic change, or intermarriage with princesses from a distance) favored one or another local group of gods or particular deity, so the hierarchical order and the very character of the deities shifted. Thus, when the Hyksos came into power, a Semitic dynasty, they favored especially the god *Set*, whom they fancied identical with their own Sedeq or El-Shaddai. They took him for their providential leader, and discouraged the worship of the other gods. But when, by their oppressions, they had stirred up the Egyptians, at length, to revolt, and were driven out of the country, Set, though before an honored deity, was now associated with all that was evil, and was credited with entire malevolence, and made, instead of Apap, the serpent of darkness, the great antagonist of the beneficent Osiris. The hatred of the Egyptians for the very *name* of Set was carried so far that it was chiseled out of the monuments; the day that had been dedicated to him became the Black Friday of the Egyptians; and the animals chosen to symbolize him were the most hateful monsters known to them, the crocodile and the hippopotamus: he became, in short, the almighty destroyer and blighter—the great devil of their pantheon.

This is no isolated instance. Repeatedly do we find wars between nations, arraying their gods, in the popular belief, in hostility; and the only historical record we have of the military conflict is the myth of the wars between the supernatural guardians of the different peoples. Such a myth is that of the wars between the Hellenic gods and the Titans and giants, and the celestial usurpation by which Zeus and Apollo drive Saturn from his throne, banishing the sons of earth to the regions of night and death, burying Enceladus under Etna, and fastening Prometheus by eternal fetters to his rock of punishment. The historical fact beneath this is the struggle between the celestial deities of the Aryan invaders and the rude, burly peasant gods of the peasant aborigines.

Similarly, out of the conflicts of the Iranians with their brother-people, the Brahmans—whom they seem at first to have accompanied in their migration from Bactria—we have a religious change of a notable character. One part of the immigrants, the Iranians, seemed to desire to cease their wanderings and adopt a settled agricultural life; the other were unwilling to do so, and would not respect the inclosed fields of the Iranians. Hence an hereditary feud, that antagonized them religiously as well as politically. Originally, both the words *devas*, i. e., the bright ones, and *asuras*, the living ones, were used as names of the Aryan gods, both terms being terms of respect and love. But gradually the term *deva* came to be the favorite with the Brahmans, and the term *asura* or *ahura* the favorite with the Iranians. But, after the feud broke out, we find the *asuras* of the Iranians becoming such an object of dislike to the Brahmans that gradually the

word ceased to be used for the good gods, to whom the term *devas* was appropriated. And to the Iranians, the *devas* of their foes became so hateful that the word became synonymous with evil spirit—a meaning still retained in our word devil. Out of the throes of this bitter early contest of the Parsees came that trumpet-call to intensest and unceasing struggle against all sin and impurity and wickedness that put the religion of Zarathushtra on such an astonishingly lofty moral plane.

Thus, when two nations stand for a length of time in hostility, neither prevailing, the result is usually to intensify the special peculiarities in the faith of each and widen their diversity. But, when one *conquers* the other, the result is generally to amalgamate the religions of the two peoples, in more or less degree. It is natural, of course, that the faith of the subjected people should be shaped over in the mold of the victor's faith. But the reverse of this is almost equally common, and we repeatedly see, as we follow down the course of history, the race conquered in battle gradually reasserting itself under the new *régime*, and subduing the conquerors, socially and religiously, by infusing among them the customs and faith they had sought at first to trample under foot. Thus, we find the Turanian peoples whom the Iranians subdued in Persia retaliating upon the victors, by unconsciously, as the years went by, introducing into the higher Zarathushtran faith the doctrine of the *fravashis*, or ancestral tutelary spirits, the magical practices and excessive adoration of fire, and the *soma*, or drink of immortality—none of which seemed native to the Aryan religion.

So in the Brahman religion, the idea of the transmigration of souls, quite absent from the early Vedic hymns, becomes, when we reach the time of the collection called the laws of Manu, one of the most prominent features of the religion. Unknown as it is in all other branches of the Aryan family, its rise and prominence among the Brahmans are to be referred to the pre-Aryan occupants of the Ganges Valley, whom the Aryans conquered and absorbed, and from whose belief in it the Brahmans derived it, when, at length, the conquerors and conquered had been fused together into one people. So with the animal-worship of Egypt, so opposite in character to the worship of Osiris and Ra. It is best explainable as a remnant of the religion of the inferior people who inhabited the land of the Nile in far remote ages, and who were subdued by the emigrants from Asia, who brought higher knowledge and a more spiritual faith with them and founded the wonderful civilization that in ancient times distinguished that land. The new faith, unfortunately, could not wean the common people altogether from their grosser faith, but was forced to receive much of it into itself.

Again, we may notice the influence of political considerations, in establishing some of the peculiar institutions of religion, such as that

of caste, which has played such a great *rôle* in Hindoo society. In the oldest hymns of the Vedas, we find no mention of it. It arose out of the bitter struggles against the non-Aryan people—the dark race, whom, at last, they succeeded in conquering. The word for *caste-varna* means kind or color, and indicated at first the difference between the whiter conquering race and the darker-tinted race whom they subdued, and with whom they would brook no slightest intercourse nor mixture, no relation but that of a slave to his masters.

This strong antipathy of race and bitter contempt for all who could not fight, nor recite the sacred hymn, petrified into impassable barriers. Pride of birth and intolerance of spirit united to increase these hereditary disabilities, and the priestly class did not fail to fan the fire of superstition that gave them such privileges. But, much as the Brahmans, at first and probably since, have congratulated themselves on the advantages of the institution, the student of history beholds, as its product, the most bitter fruit—an intolerable rigidity, a cumbrous ceremonialism, and the alienation and degradation of the common people. It was no wonder that ere long Buddhism should arise, and in the strength of the popular disaffection sweep over all India, and if, in another century, it lost this conquest, yet should go on in triumphant march over Eastern Asia, till it came to number more souls in its ranks than any other faith.

4. We must notice the great influence of man's varied social conditions in differentiating religious belief. The level of religion with any people corresponds to the general level of social organization and refinement. "Thou art fellow with the spirit that thy mind can grasp," is the pregnant monition of Mephistopheles in Goethe's "Faust." The coarse, imbruted, petty-minded man can not entertain any high or pure notions of God. The negroes of the West Coast represent their deities as black and mischievous, delighting to torment men in various ways. The god of the Polynesian cannibals is believed by them to feed on the souls of the men sacrificed to him, as they themselves do on the bodies. When the negro's fetich does not bring him good fortune, the stock or stone gets a drubbing.

Among tribes that still remain in the predatory state, subsisting by hunting, and continually resorting to plunder and war, we find religion in its crudest forms. Animal-worship, great regard for omens and use of magic, and shamanistic practices of all sorts, swarm in their religions. Their rites are apt to be cruel and their sacrifices bloody, often demanding human victims. The religions of the warlike negroes of the Gold Coast, the Feejee-Islanders, and the hunting tribes of America, illustrate this.

Even where nations have risen to a high level of civilization, but have retained their military habits, as the Assyrians and the Aztecs, e. g., there the sanguinary and revolting character of their religion shows the same influence. On the other hand, where pastoral life pre-

vails, there, as among the Hottentots and Caffres, religion has a milder aspect; while, among those tribes which, besides cattle-breeding and agriculture, have engaged also in industry and commerce, a still more humane spirit characterizes their worship.

A similar difference, though on a less pronounced scale, is seen in the two elements that united to form the Greek nation. The older stock, whose blood ran in the peasantry, were a half-savage people and their gods consequently rude—half-bestial satyrs and centaurs, black Demeters, images of the unsown earth; mountain Titans, uncouth Pan; thievish, tricksy Hermes; the mighty but reckless, wanton Heracles, type of the red and angry sun, gods but half-focused in the minds of their own worshipers, and represented often by rude blocks of wood and stone. But these could not content the spiritual demands of the later comers, the more polished Iranians, finer of temperament, and imbued by their contact with the civilization of Asia Minor with higher tastes. So we find among them more graceful and elevated gods—stately Hera and chaste Artemis, heaven-born Pallas and the beauteous Apollo—noble ideals of the highest manhood and womanhood that they could conceive.

And as civilization still further progresses, as peace and law become the rule in the community, as arts and knowledge increase, the conceptions of the divine and the worship suitable for him rise proportionately. With the exacter study of nature, sorcery and omens become less credible. The gods themselves are seen to be subject to an unchangeable order. Indications of intelligence, of goodness, and of rectitude in the world, point irresistibly to a divine with the high attributes from which alone these effects can proceed. As the reason grows, the crude polytheism in which man at first rested is found environed with perplexities and inconsistencies. Reason pushes steadily toward the universal and the single. If the thunder-cloud was a divine being, why not every *drop* of rain that fell? If the lion or bull was a god, why not every fly and midge? In revolt against such cheapening of the idea of divinity, there would arise, with the development of intelligence, a tendency to absorb the host of gods in fewer and more potent gods. Next, the interaction of nature's processes would be noted. The fire that warms the house is recognized as essentially one and the same force with that which flushes the sky at dawn, flashes from the solar orb, or gleams in the lightning's quick illumination: "Thou Agni," as the Vedic poet at length cried—"thou Agni art Indra, art Vishnu, art Brahman-aspati. Thou Agni art born Varuna, becomest Mitra when kindled. In thee, son of strength, art all the gods."—("Rig-Veda," vii, 30, 31, vii, 1–3.)

As observation widens, then, the diverse parts of nature are more and more woven into one web. The various deities are recognized as but *aliases* under which a single power hides. The unity of the world forbids us to think of it as the prey of numberless capricious and in-

dependent personalities. Thus the early scientific investigators, as Anaxagoras and Parmenides, necessarily broke with polytheism, and proclaimed the essential oneness of that power from which all came. Men of philosophic spirit everywhere, whether in India, Egypt, China, or Rome, have pressed behind the confusing throng of pagan pantheons, to reach some elder, more eternal, more majestic, and absolute power behind them all. Nutar = the power ; Tao = the eternal principle ; Akevana Zarvana = boundless time ; Brahma = the supernatural essence of all. The questions, "Whence has all come? What is the source of all?" have become more and more urgent. One after another, the idols of ancient belief have been broken by the iconoclastic hammer of fuller knowledge, and the yearning arms of faith, that *must* embrace some adored object, have reached up to purer conceptions of the divine, more worthy of worship.

Or when, on the contrary, civilization is decaying, and the incursions and conquests of barbarians are, from century to century, making society coarser and rougher, as happened in Europe from the fifth to the tenth century, then we see a corresponding degeneration in religion.

How lofty and pure the spiritual truths that Jesus taught! And, in the simple, ingenuous narratives of the gospel, what an anchor to the Christian Church to keep it, one would think, from ever drifting far away from its original place! And yet, what melancholy degradation, what gross perversions, did Christianity lapse into among the dissolute Greeks and Romans, the rude Franks and Vandals! As we study mediæval Christianity, with its belief in witchcraft and all sorts of pious and impious magic ; its melancholy asceticism ; the gross worship of saints, relics, and images, and deifications of Virgin and eucharistic bread and wine ; with its martial, steel-clad bishops, ready to fight in public as in private ; with its exaltation of ceremony above morality, and investment of priest and pope with supernatural power and authority—it seems almost incredible that the glad-tidings of the gospel, the simple faith that started as a message of peace on earth and goodwill to men, could ever have been transformed into this. It is only by the irresistible influence of a corrupt society in the first place, and, secondly, of a barbarous society, that it is at all explainable.

The first forms of religion have well been called a kind of primitive philosophy. So, full-fledged philosophy has been the constant pioneer of a purer theology, and the diverse speculations of the intellect, from the days of Ptah-hotep and Lao-Tsee down to those of Hegel and Cousin, have been prominent forces in giving pious hearts their special directions in the religious field. According as the metaphysics of a people varies—following the empiric or the intuitive, the positive or the idealistic type—so will its religion vary. See, e. g., what a different thing Buddhism developed into among the nation of positivists, the Chinese, from the form it took among the idealistic Brahmans.

The student of history, as he looks back at the great religious movements of the world, can discern how each great wave of spiritual feeling was preceded, prepared for, and received its direction from, some philosophic current. Aristotle, e. g., did more to determine the special phase of mediæval Christendom than any of its popes. These four philosophers, Kant, Hegel, Stuart Mill, and Herbert Spencer, surpass in their influence on the religious situation any forty theologians who can be mentioned. Religion at certain epochs, such as that of the Hindoo Upanishads, the Neoplatonism of the second and third centuries, or the mediæval scholasticism, is but philosophy in priestly robe.

As religions develop, the work of conscious thought and reasoning becomes greater and greater. It is these that mold the warm and impressible wax of pious feeling into such different theologic types. It is these that draw up creeds, and that define doctrines with ever-increasing detail; that subtilize over the pre-existent state of great prophets, that invent theories of incarnation and transubstantiation, and that multiply dogmatic distinctions and schemes of salvation, until the sects become multitudinous. And, if this may be said to the discredit of metaphysic speculation, to its credit, on the other side of the account, we may put the fact that it is only through the influence of the philosophic reason that religion is exalted above dull naturalism or sensuous anthropomorphism. It is impossible, by mere observation and induction, to ascend from the imperfect creation to the perfect divine. The finite universe may suggest a being of vast power and astonishing wisdom, but it demonstrates no infinitude. All that we draw from nature and the human is of the relative and transient order, and supplies no warrant to us of any absolute and eternal. Rude and uneducated minds are always found investing Deity with physical characteristics and human imperfections. "God is a good man," said Dogberry, and, to the sensuous thought, he is to-day but little more than the magnified image of our own humanity. It is by philosophic training alone that we learn to analyze and carry out to their rational conclusions those principles of reason which demand of us to recognize as most characteristic of God's attributes, beyond anything that either nature or the human body presents, those attributes of infinity, perfection, and absolute existence, which constitute true divinity.

5. Similarly the *moral* condition of a people is a most important variable in its development. Ideas of heaven and hell correspond to the moral elevation of the community. The warlike Maori imagined life after death a constant series of battles, in which the gods are always victorious. The Moslem's paradise excites our disgust by its sensualities; the Greek's, by its trivialities. It is only where the moral nature is elevated that heaven is ennobled to a place worthy the longings of a manly man.

God-fearing armies, as Carlyle tells us, are the best armies. So, as Bagehot has pointed out, those kinds of morals and that kind of religion which tend to make the firmest and most effectual character are sure to prevail, all else being the same; and creeds or systems that conduce to a soft, limp mind tend to perish. Strong beliefs win strong men, and then make them stronger. Such is, no doubt, another cause why monotheism tends to prevail over polytheism. It at once attracts and produces steadier character. It is not confused by competing rites nor distracted by miscellaneous duties.

As in man, at the outset, the moral and spiritual faculties lie mostly latent, overshadowed by his animal wants and passions, so the gods, in whose image he fashions at first the dimly discerned divine, are beings of physical power and sensuous nature, personifications of giant strength, imperative will, terrible passions, dangerous to arouse—a wanton Mylitta, a thievish Hermes, an implacable Pluto, the Moloch only to be propitiated by giving him the best-beloved child to devour in his sacred flame; or a burly Thor, whose hammer-blows rive huge valleys in the ground, to whom any deceit by which he may overcome his foes is entirely allowable.

From this low nature range, where morality is not yet known, the conceptions of the gods move up to the philosophic level, and from that to the ethical range. The Hindoo Rita, at first simply the fixed path of the sun or other heavenly bodies, became, as the next step, generalized in *law* or *order* in the abstract; and then was exalted into the celestial path of rectitude and peace, the eternal power making for righteousness. Osiris, at first the setting sun, becomes next the mysterious principle of life and harmony; then, the great judge of men's conduct, the source of good.

All nature-religions, derived as they are from the physical world and its processes, and originating in the infancy of civilization, are ethically imperfect. They are not *immoral*, so much as innocent of those distinctions, modesties, and virtues, to which so much regard is later given. But, just because of this, many incidents of their sacred histories come in time to seem impure and revolting. While Zeus was clearly recognized as the sky that fertilizes the earth and quickens nature, the myths of his manifold amours—how, in swan-garb of feathery cirrhus, he approaches and overshadows Leda; how in a shower of golden, sunlight rain he impregnates Danaë, the imprisoned earth of frosty spring—all these would be intelligible and inoffensive. But when Zeus became the supreme ruler of earth and heaven, the all-holy law-giver, then men could not but soon find these narratives shocking to their moral sense. We do not easily bear the thought that the objects of our worship should be inferior in any respect to ourselves. When this is felt, then the worship must be radically reformed, or it falls before some faith of purer type.

All the great universal religions—Buddhism, Christianity, and

Mohammedanism—are distinguished for their high moral quality, and by this won their glorious victories; and their crystallization in the heart of a noble-minded prophet and reformer was in each case preceded by a great social and moral quickening throughout the community in which they arose. When the depths of the human heart are moved and the imperative claims of justice, truth, and purity once perceived, then the death-knell of mere nature-worship has been rung in that land. As the pagan god, Wäinamöinen, in the Finnish epic of the Kalevala, when he hears of the birth of Christ, enters his canoe and paddles away to the northern wastes of snow and silence, so must the worship of force give way to the more majestic divinity of conscience. The varied influences of man's environment conspire with the aspiring instincts of his in most soul to conduct him constantly out of the imperfect toward the perfect. Whether or not he reach it, it is *that* that must be the goal of his striving.

ISCHIA AND ITS EARTHQUAKES.

By M. CH. VÉLAIN.

THE island of Ischia, which has recently been so terribly rent by an earthquake, is situated in the northwestern part of the Bay of Naples, and near the Phlegrean fields, with which the little island of Procida, likewise volcanic, constitutes a connecting link. It forms a part of the Neapolitan volcanic region, which may be considered as still in a state of solfatarian activity, which is exemplified by the well known solfatara of Puzzuoli, where the sulphur is re-deposited, as far as it is mined, by numerous gaseous emanations, and by the escape of carbonic acid in the *Grotto del Cane* near Lake Agnano. All of these exhalations, which are the mark of a declining volcanic activity, attest that this region, situated on a great line of fracture running northwest and southeast from Vesuvius to Vultura, is still in direct communication with the subterranean sources. The ancients fully recognized this, and regarded all those explosive craters, now transformed into a chain of remarkably picturesque lakes across the Phlegrean fields, as so many doors of Tartarus through which the infernal divinities took souls to the banks of the Acheron. The most celebrated of them, Lake Avernus, "*Atri Janua Ditis*" (the gate of black hell), now smiling and salubrious, then exhaled torrents of suffocating gases which well justified its name, and rendered a stay there mortal to the birds that ventured into its neighborhood.

The Neapolitan volcanic region extends from Vesuvius to Vultura, on the eastern edge of the Apennines, and includes the Phlegrean fields and the connected islands of Ischia and Procida. The volcanic activity

of this whole space is now concentrated at Vesuvius, and is manifested at other places in the vicinity only by the emanations and thermal springs of which we have spoken, and from time to time, during periods when the volcano is inactive, by violent shocks, of which the terrible disaster of the 28th of July, at Ischia, has just given an impressive example.

Previous to the Christian era, Vesuvius, covered with a rich vegetation, was wholly inactive. Nothing except the form of the mountain could give a suspicion of the intensity of the fires that were raging beneath it. Volcanic activity, then localized in the Phlegrean fields,

FIG. 1.—BAY OF NAPLES. GEOLOGICAL MAP SHOWING THE RELATIONS OF ISCHIA WITH THE PHLEGREAN FIELDS.

attained its maximum in Ischia, which was its escape-valve during the entire period of Vesuvian quiet. It produced then, through the action of a large number of eruptions taking place within a period of several thousand years, a considerable island, which now rises more than eight hundred metres, or two thousand six hundred feet, above the level of the sea. It is eighty kilometres, or a little less than fifty miles, in circumference at the level of the sea, eight kilometres, or not quite five miles, long from east to west, and eight kilometres, or about three miles, broad. From its center rises Mount Epomeo, which, crowned by an abrupt, semicircular rampart, which is nothing else than the eastern edge of the grand crater, whence have issued all the trachytic projections that now form the greater part of the island, presents the somber aspect of a fire-vomiting mountain. This crater has never given out lavas. Built on masses of pumiceous tufas of slight con-

sistency, the lava-flows have always been produced upon the slope or at the base of the mountain. At each of the orifices of issue the projections forced out by tumultuous jets of gas have formed adventitious cones of dimensions often considerable, like those of il Toppo, il Trippiti, and il Garifoli; and we may count some ten such cones around Epomeo, all of which have been centers of activity and furnished large flows.

The appearance of Ischia was relatively of recent date; it is not placed farther back than the older quaternary. The foundation of the island was begun by submarine eruptions, above which opened the crater of Epomeo, at first appearing above the surface of the sea as an annular reef, from which were thrown out jets of trachytic scoria. The island was raised up in successive stages by the accumulation of the projected matter around the orifice of issue. The proof of this is drawn from the fact that we may still find on the sides of Mount Epomeo, carried to a height of four hundred and seventy metres, masses of marine shells of species yet living in the Mediterranean, encased in clays that have resulted from the decomposition of trachytic tufas under water. The whole of this trachytic mass is itself established on marls and clays, including numerous remains of Mediterranean shells, and has evidently acquired its present relief within the historical epoch.

The most ancient of the recorded eruptions in Ischia was that of Montagnone, to which is ascribed the origin of the vast crater of regular form that still existed before the recent earthquake, in a state of perfect preservation, in the northwestern part of Ischia. About 470 B. C., successive eruptions at Point Comacchia gave rise to the vast flows of Manecoco and Bale, which extended far into the sea and prolonged the point to the north. Numerous efforts have been made since these ancient times to plant colonies on this unstable land, even then fertile and covered with a luxuriant vegetation.

Lyell, who made a long exploration of the island in 1828, relates that first the Erythreans and afterward the Chalcideans, who had settled in the island before the Christian era, were driven away by the incessant earthquakes and the mephitic exhalations escaping from every point. At a later time, 280 B. C., Hiero, king of Syracuse, tried to found a colony there, but it was soon driven away by a formidable explosion preceding the great flows of lava which gave rise to the masses now forming the promontories of Zaro and Camso.

The same fate befell the Grecian colonies which afterward tried at different times to occupy the island. The eruption that forced the retreat of the first Grecian colony gave rise to Monte Rosato, that cone of projections the sudden formation of which is comparable to that of Monte Nuovo. The last-named mountain was raised in September, 1538, in forty-eight hours, at Puzzuoli, after a succession of formidable shocks which occasioned great disasters in the Phlegrean

fields and destroyed a great number of Roman buildings. These two mountains of volcanic erection, formed under similar conditions, at two distinct epochs corresponding in each case with a period of repose in Vesuvius, are distinguished by their regular form, which may be compared with that of the classic volcanoes of the chain of the *puys* of Auvergne. Both, terminating in a vast crater, have emitted, like the volcanoes of Auvergne, only a single flow of lava, which seems to have exhausted all their energy. A long period of repose followed. During more than a century "Ischia the Joyous," as it was called, rested in perfect tranquillity. The pleasure-loving Romans made of it the most enchanting resort in the world; all their magnates had villas there.

It is to be remarked that this period of repose was correspondent with a resumption of activity on Vesuvius. The first symptom of an awakening of energy in that volcano was an earthquake, which in the year 68 occasioned considerable damage in the neighboring towns. We know well how, eleven years later, in 79, the hitherto peaceful mountain, covered at the time with rich plantations and forests nearly to its crater, revealed by a sudden explosion the terrible force that was sleeping in its depths. La Somma, reduced to powder, was projected into the air; then a column of thick smoke was seen to rise vertically from the summit of the mountain, and to spread horizontally, covering the country under its immense shadows. The sun was obscured even as far as to Rome, and it was believed that the "great night of the earth" was about to begin. When light was restored, the dismantled mountain had changed its form; the luxuriant forests that had covered it had disappeared, and so had the populous cities of Herculaneum, Pompeii, and Stabiæ, buried, with their inhabitants, under ashes and volcanic *débris*. From this time, Vesuvius does not appear to have emitted any eruption of lava for several hundred years; and this period of quiet at that center seems to have been marked at Ischia by a resumption of the fires of Epomeo, which had enjoyed so long a rest that large forests had grown up to the very edge of its crater. In 1302, after the island had been shaken with a succession of earthquakes during the previous year, the lava gushed out by a new opening near the city of Ischia, and in less than four hours reached the sea, having destroyed everything in its passage as if it had been a torrent of fire. The city was terribly afflicted; large houses and numerous villas were buried, with their inhabitants. The rough surface of this lava stream has resisted all weathering, and still refuses to bear any vegetation. The new eruptive phase was of long duration, and it is remarked that while it continued Vesuvius was quiet. The alternations between the eruptive movements of lava in the two volcanic centers find a natural explanation in the facts that they are both on the same line of fracture, and a subterranean communication probably exists between them.

Epomeo became tranquil after Vesuvius resumed its eruptions; and for long series of years the island of Ischia had no other outlets for the escape of the gases generated in its depths than its thirty or forty thermal springs, which have contributed, together with the pure air and the beauty of the situation, to increase every year the crowd of visitors.

Every indication tends to support the belief that Ischia, a rival to Vesuvius in the height of its volcano, is an ancient cone composed of the matter thrown up by extremely violent submarine eruptions which took place before the present epoch. As the mountain increased in height through the successive accumulations of the trachytic projections from the central crater, the weaker parts of its flanks, yielding to the height of the liquid column in the vent, were cleft in every direction; the injection of lavas into all the fissures thus formed giving rise to the flows we have just mentioned, melted in with and consolidated the structure, which is thus the result of a protracted alternation of projected *débris* and flows of compact lavas. We can in this manner account for the disposition of the grand ravines which, descending from Epomeo, plow the flanks of the mountain to a great depth.

FIG. 2.—COAST OF ISCHIA, SEEN FROM THE WEST, POINT COMACCHIA.

The island has, therefore, been progressively raised above the waters, and has grown laterally during the historic period, as is testified by the flows of lava still visible on the Arso and on Monte Tabor, which are prolonged to the sea, and by the numerous secondary cones scattered over its plateaus. It definitely acquired its present relief toward the beginning of this century. Since that time, Mount Epomeo has not given any other signs of its volcanic character than those which the scientific observer might deduce from the analogy of its form with the forms of other volcanoes. Its arid, slashed summit, looking up to the sky, served as the end of the promenade for the numerous visitors who every summer frequented the thermal stations at Casamicciola, Castiglione, and San Lorenzo. Its springs, highly endowed with thermal qualities, and the exceptional fertility of its volcanic soil, on which small shrubs became arborescent, would have sufficed to give to the fortunate, healthful, and gay island great wealth, had not its earthquakes always caused apprehensions.

These disturbances of the earth, the relations of which with the volcanic structure are most evident have repeatedly brought frightful disasters upon Ischia. Hardly a trace of the splendid Roman structures once built upon it now remains; without mentioning specifically

all the recorded earthquakes, that of 1881, which is still comparatively fresh in memory, partly destroyed the city of Casamicciola, which has now been obliterated. It gave a warning by which no one knew how to profit. The constitution of the soil of the island, which is com-

FIG. 3.—CASTLE OF ISCHIA.

posed chiefly of trachytic tufas and unconsolidated loose matters, is a considerable element in promoting these disasters.

The Ischian earthquakes are narrowly localized. Their origin is not doubtful, but is readily traceable to the efforts which the lavas and the gases, strongly compressed under the earth, make to escape. Their effects never extend to great distances. The catastrophe which has just consummated the destruction of Casamicciola, already severely shaken in 1881, is a striking example of them. A violent shock, quick as the firing of a cannon, was enough to unsettle and partly destroy the whole northern slope of the island. Procida, which was near it, was shaken, but only a few rumblings in the earth were felt on the neighboring coast. The phenomena are marked by vertical shocks, acting only upon a definite point, and violent in proportion as they are limited in extent. These shocks are propagated irregularly, without continuity, by sudden starts, across the trachytic tufas forming the subsoil of the island. Slides of the ground are thus produced, which carry off with them cultivated fields and buildings. One is sometimes tempted to compare them, on account of the formidable subterranean sounds that accompany them, and of their suddenness, to mine explosions; but the illustration would be badly chosen, for these movements have never caused a sudden rising of the soil, and there is nothing about them comparable to the disturbances produced by an explosion.

They are rather sinkings down, into a soil already cracked and

partly disintegrated by the thermal waters, that have produced all these disasters which we now know have been greater in the neighborhood of the points where these springs are most active and most abundant. Casamicciola, where the hydro-thermal activity of the island is concentrated, has been destroyed forever, for prudence will demand that it never be rebuilt. A single house remains standing in the midst of that disorder of ruins and that accumulation of dead bodies that now cover the site of a watering-place once so prosperous and so thronged. The city of Ischia itself has suffered severely; Loco Ameno exists no more; Forio is almost in ruins; Porto d'Ischia has also been very much tried; and we might say that there is not one of those picturesque villas, hung upon the mountain-side, or hidden in the verdure of the valleys, that has not been damaged; and the number of victims buried under the mass of ruins will probably never be fully ascertained.

We shall have to go very far back in the history of the Neapolitan volcanoes to find an example of another such catastrophe. Since Herculaneum and Pompeii were buried under a cover of ashes and lava, the most recent great disaster we can at all compare with the destruction of Ischia is that of Potenza, which, in December, 1857, cost the lives of more than ten thousand persons. This was in Calabria—that is, in one of the provinces between Vesuvius and Etna, which have frequently been subjected to terrible disturbances.—*Translated for the Popular Science Monthly from La Nature.*

A PLEA FOR PURE SCIENCE.*

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THE question is sometimes asked us as to the time of year we like the best. To my mind, the spring is the most delightful; for Nature then recovers from the apathy of winter, and stirs herself to renewed life. The leaves grow, and the buds open, with a suggestion of vigor delightful to behold; and we revel in this ever-renewed life of Nature. But this can not always last. The leaves reach their limit; the buds open to the full, and pass away. Then we begin to ask ourselves whether all this display has been in vain, or whether it has led to a bountiful harvest.

So this magnificent country of ours has rivaled the vigor of spring in its growth. Forests have been leveled, and cities built, and a large

* Vice-Presidential Address delivered before Section B, of the American Association for the Advancement of Science, August 15, 1883. Abridged for The Popular Science Monthly.

and powerful nation has been created on the face of the earth. We are proud of our advancement. We are proud of such cities as this, founded in a day upon a spot over which, but a few years since, the red-man hunted the buffalo. But we must remember that this is only the spring of our country. Our glance must not be backward; for, however beautiful leaves and blossoms are, and however marvelous their rapid increase, they are but leaves and blossoms, after all. Rather should we look forward to discover what will be the outcome of all this, and what the chance of harvest. For, if we do this in time, we may discover the worm which threatens the ripe fruit, or the barren spot where the harvest is withering for want of water.

I am required to address the so-called physical section of this Association. Fain would I speak pleasant words to you on this subject; fain would I recount to you the progress made in this subject by my countrymen, and their noble efforts to understand the order of the universe. But I go out to gather the grain ripe to the harvest, and I find only tares. Here and there a noble head of grain rises above the weeds; but so few are they that I find the majority of my countrymen know them not, but think that they have a waving harvest, while it is only one of weeds, after all. American science is a thing of the future, and not of the present or past; and the proper course of one in my position is to consider what must be done to create a science of physics in this country, rather than to call telegraphs, electric lights, and such conveniences, by the name of science. I do not wish to underrate the value of all these things: the progress of the world depends on them, and he is to be honored who cultivates them successfully. So also the cook who invents a new and palatable dish for the table benefits the world to a certain degree; yet we do not dignify him by the name of a chemist. And yet it is not an uncommon thing, especially in American newspapers, to have the *applications* of science confounded with pure science: and some obscure American who steals the ideas of some great mind of the past, and enriches himself by the application of the same to domestic uses, is often lauded above the great originator of the idea, who might have worked out hundreds of such applications, had his mind possessed the necessary element of vulgarity. I have often been asked which was the more important to the world, pure or applied science. To have the applications of a science, the science itself must exist. Should we stop its progress, and attend only to its applications, we should soon degenerate into a people like the Chinese, who have made no progress for generations, because they have been satisfied with the applications of science, and have never sought for reasons in what they have done. The reasons constitute pure science. They have known the application of gunpowder for centuries; and yet the reasons for its peculiar action, if sought in the proper manner, would have developed the science of chemistry, and even of physics, with all their numerous applications. By contenting

themselves with the fact that gunpowder will explode, and seeking no further, they have fallen behind in the progress of the world; and we now regard this oldest and most numerous of nations as only barbarians. And yet our own country is in this same state. But we have done better; for we have taken the science of the Old World, and applied it to all our uses, accepting it like the rain of heaven, without asking whence it came, or even acknowledging the debt of gratitude we owe to the great and unselfish workers who have given it to us. And, like the rain of heaven, this pure science has fallen upon our country, and made it great and rich and strong.

To a civilized nation of the present day, the applications of science are a necessity; and our country has hitherto succeeded in this line, only for the reason that there are certain countries in the world where pure science has been and is cultivated, and where the study of nature is considered a noble pursuit. But such countries are rare, and those who wish to pursue pure science in our own country must be prepared to face public opinion in a manner which requires much moral courage. They must be prepared to be looked down upon by every successful inventor whose shallow mind imagines that the only pursuit of mankind is wealth, and that he who obtains most has best succeeded in this world. Everybody can comprehend a million of money; but how few can comprehend any advance in scientific theory, especially in its more abstruse portions! And this, I believe, is one of the causes of the small number of persons who have ever devoted themselves to work of the higher order in any human pursuit. Man is a gregarious animal, and depends very much, for his happiness, on the sympathy of those around him; and it is rare to find one with the courage to pursue his own ideals in spite of his surroundings. In times past, men were more isolated than at present, and each came in contact with a fewer number of people. Hence that time constitutes the period when the great sculptures, paintings, and poems were produced. Each man's mind was comparatively free to follow its own ideals, and the results were the great and unique works of the ancient masters. To-day the railroad and the telegraph, the books and newspapers, have united each individual man with the rest of the world: instead of his mind being an individual, a thing apart by itself, and unique, it has become so influenced by the outer world, and so dependent upon it, that it has lost its originality to a great extent. The man who in times past would naturally have been in the lowest depths of poverty, mentally and physically, to-day measures tape behind a counter, and with lordly air advises the naturally born genius how he may best bring his outward appearance down to a level with his own. A new idea he never had, but he can at least cover his mental nakedness with ideas imbibed from others. So the genius of the past soon perceives that his higher ideas are too high to be appreciated by the world; his mind is clipped down to the standard form; every natural offshoot upward is repressed,

until the man is no higher than his fellows. Hence the world, through the abundance of its intercourse, is reduced to a level. What was formerly a grand and magnificent landscape, with mountains ascending above the clouds, and depths whose gloom we can not now appreciate, has become serene and peaceful. The depths have been filled, and the heights leveled, and the wavy harvests and smoky factories cover the landscape.

As far as the average man is concerned, the change is for the better. The average life of man is far pleasanter, and his mental condition better, than before. But we miss the vigor imparted by the mountains. We are tired of mediocrity, the curse of our country. We are tired of seeing our artists reduced to hirelings, and imploring Congress to protect them against foreign competition. We are tired of seeing our countrymen take their science from abroad, and boast that they here convert it into wealth. We are tired of seeing our professors degrading their chairs by the pursuit of applied science instead of pure science; or sitting inactive while the whole world is open to investigation; lingering by the wayside while the problem of the universe remains unsolved. We wish for something higher and nobler in this country of mediocrity, for a mountain to relieve the landscape of its monotony. We are surrounded with mysteries, and have been created with minds to enjoy and reason to aid in the unfolding of such mysteries. Nature calls to us to study her, and our better feelings urge us in the same direction.

For generations there have been some few students of science who have esteemed the study of nature the most noble of pursuits. Some have been wealthy, and some poor; but they have all had one thing in common—the love of nature and its laws. To these few men the world owes all the progress due to applied science, and yet very few ever received any payment in this world for their labors.

Faraday, the great discoverer of the principle on which all machines for electric lighting, electric railways, and the transmission of power, must rest, died a poor man, although others and the whole world have been enriched by his discoveries. And such must be the fate of the followers in his footsteps for some time to come.

But there will be those in the future who will study nature from pure love, and for them higher prizes than any yet obtained are waiting. We have but yet commenced our pursuit of science, and stand upon the threshold wondering what there is within. We explain the motion of the planet by the law of gravitation; but who will explain how two bodies, millions of miles apart, tend to go toward each other with a certain force?

We now weigh and measure electricity and electric currents with as much ease as ordinary matter, yet have we made any approach to an explanation of the phenomenon of electricity? Light is an undulatory motion, and yet do we know what it is that undulates? Heat

is motion, and yet do we know what it is that moves? Ordinary matter is a common substance, and yet who shall fathom the mystery of its internal constitution?

There is room for all in the work, and the race has but commenced. The problems are not to be solved in a moment, but need the best work of the best minds, for an indefinite time.

Shall our country be contented to stand by, while other countries lead in the race? Shall we always grovel in the dust, and pick up the crumbs which fall from the rich man's table, considering ourselves richer than he because we have more crumbs, while we forget that he has the cake, which is the source of all crumbs? Shall we be swine, to whom the corn and husks are of more value than the pearls? If I read aright the signs of the times, I think we shall not always be contented with our inferior position. From looking down we have almost become blind, but may recover. In a new country, the necessities of life must be attended to first. The curse of Adam is upon us all, and we must earn our bread.

But it is the mission of applied science to render this easier for the whole world. There is a story which I once read, which will illustrate the true position of applied science in the world. A boy, more fond of reading than of work, was employed, in the early days of the steam-engine, to turn the valve at every stroke. Necessity was the mother of invention in his case: his reading was disturbed by his work, and he soon discovered that he might become free from his work by so tying the valve to some movable portion of the engine as to make it move its own valve. So I consider that the true pursuit of mankind is intellectual. The scientific study of nature, in all its branches, of mathematics, of mankind in its past and present, the pursuit of art, and the cultivation of all that is great and noble in the world—these are the highest occupations of mankind. Commerce, the applications of science, the accumulation of wealth, are necessities which are a curse to those with high ideals, but a blessing to that portion of the world which has neither the ability nor the taste for higher pursuits.

As the applications of science multiply, living becomes easier, the wealth necessary for the purchase of apparatus can better be obtained, and the pursuit of other things besides the necessities of life becomes possible.

But the moral qualities must also be cultivated in proportion to the wealth of the country, before much can be done in pure science. The successful sculptor or painter naturally attains to wealth through the legitimate work of his profession. The novelist, the poet, the musician, all have wealth before them as the end of a successful career. But the scientist and the mathematician have no such incentive to work: they must earn their living by other pursuits, usually teaching, and only devote their surplus time to the true pursuit of their science.

And frequently, by the small salary which they receive, by the lack of instrumental and literary facilities, by the mental atmosphere in which they exist, and, most of all, by their low ideals of life, they are led to devote their surplus time to applied science or to other means of increasing their fortune. How shall we, then, honor the few, the very few, who, in spite of all difficulties, have kept their eyes fixed on the goal, and have steadily worked for pure science, giving to the world a most precious donation, which has borne fruit in our greater knowledge of the universe and in the applications to our physical life which have enriched thousands and benefited each one of us? There are also those who have every facility for the pursuit of science, who have an ample salary and every appliance for work, yet who devote themselves to commercial work, to testifying in courts of law, and to any other work to increase their present large income. Such men would be respectable if they gave up the name of professor, and took that of consulting chemists or physicists. And such men are needed in the community. But for a man to occupy the professor's chair in a prominent college, and, by his energy and ability in the commercial applications of his science, stand before the local community in a prominent manner, and become the newspaper exponent of his science, is a disgrace both to him and his college. It is the death-blow to science in that region. Call him by his proper name, and he becomes at once a useful member of the community. Put in his place a man who shall by precept and example cultivate his science, and how different is the result! Young men, looking forward into the world for something to do, see before them this high and noble life, and they see that there is something more honorable than the accumulation of wealth. They are thus led to devote their lives to similar pursuits, and they honor the professor who has drawn them to something higher than they might otherwise have aspired to reach.

I do not wish to be misunderstood in this matter. It is no disgrace to make money by an invention, or otherwise, or to do commercial scientific work under some circumstances. But let pure science be the aim of those in the chairs of professors, and so prominently the aim that there can be no mistake. If our aim in life is wealth, let us honestly engage in commercial pursuits, and compete with others for its possession. But if we choose a life which we consider higher, let us live up to it, taking wealth or poverty as it may chance to come to us, but letting neither turn us aside from our pursuit.

The work of teaching may absorb the energies of many; and, indeed, this is the excuse given by most for not doing any scientific work. But there is an old saying, that where there is a will there is a way. Few professors do as much teaching or lecturing as the German professors, who are also noted for their elaborate papers in the scientific journals. I myself have been burdened down with work, and know what it is; and yet I here assert that all *can* find time for scien-

tific research if they desire it. But here, again, that curse of our country, mediocrity, is upon us. Our colleges and universities seldom call for first-class men of reputation, and I have even heard the trustee of a well-known college assert that no professor should engage in research because of the time wasted! I was glad to see, soon after, by the call of a prominent scientist to that college, that the majority of the trustees did not agree with him.

That teaching is important, goes without saying. A successful teacher is to be respected; but, if he does not lead his scholars to that which is highest, is he not blameworthy? We are, then, to look to the colleges and universities of the land for most of the work in pure science which is done. Let us therefore examine these latter, and see what the prospect is.

One, whom perhaps we may here style a practical follower of Ruskin, has stated that while in this country he was variously designated by the title of captain, colonel, and professor. The story may or may not be true, but we all know enough of the customs of our countrymen not to dispute it on general principles. All men are born equal: some men are captains, colonels, and professors, and therefore all men are such. The logic is conclusive; and the same kind of logic seems to have been applied to our schools, colleges, and universities. I have before me the report of the Commissioner of Education for 1880. According to that report, there were three hundred and eighty-nine,* or say, in round numbers, four hundred institutions, calling themselves colleges or universities, in our country! We may well exclaim that ours is a great country, having more than the whole world besides. The fact is sufficient. The whole earth would hardly support such a number of first-class institutions. The curse of mediocrity must be upon them, to swarm in such numbers. They must be a cloud of mosquitoes, instead of eagles as they profess. And this becomes evident on further analysis. About one third aspire to the name of university; and I note one called by that name which has two professors and eighteen students, and another having three teachers and twelve students! And these instances are not unique, for the number of small institutions and schools which call themselves universities is very great. It is difficult to decide from the statistics alone the exact standing of these institutions. The extremes are easy to manage. Who can doubt that an institution with over eight hundred students, and a faculty of seventy, is of a higher grade than those above cited having ten or twenty students and two or three in the faculty? Yet this is not always true; for I note one institution with over five hundred students which is known to me personally as of the grade of a high-school. The statistics are more or less defective, and it would much weaken the force of my remarks if I went too much into detail. I append the

* Three hundred and sixty-four reported on, and twenty-five not reported.

following tables, however, of three hundred and thirty so-called colleges and universities:

218	had	from	0	to	100	students.
88	"	"	100	"	200	"
12	"	"	200	"	300	"
6	"	"	300	"	500	"
6	over		500			

Of three hundred and twenty-two so-called colleges and universities—

206	had	0	to	10	in the faculty.
99	"	10	"	20	" "
17	"	20	or	over	" "

If the statistics were forthcoming—and possibly they may exist—we might also get an idea of the standing of these institutions and their approach to the true university idea, by the average age of the scholars. Possibly also the ratio of number of scholars to teachers might be of some help. All these methods give an approximation to the present standing of the institutions. But there is another method of attacking the problem, which is very exact, but it only gives us the *possibilities* of which the institution is capable. I refer to the wealth of the institution. In estimating the wealth, I have not included the value of grounds and buildings, for this is of little importance, either to the present or future standing of the institution. As good work can be done in a hovel as in a palace. I have taken the productive funds of the institution as the basis of estimate. I find—

234	have	below	$500,000.
8	"	between	$500,000 and $1,000,000.
8	"	over	$1,000,000.

There is no fact more firmly established, all over the world, than that the higher education can never be made to pay for itself. Usually the cost to a college, of educating a young man, very much exceeds what he pays for it, and is often three or four times as much. The higher the education, the greater this proportion will be; and a university of the highest class should anticipate only a small accession to its income from the fees of students. Hence the test I have applied must give a true representation of the possibilities in every case. According to the figures, only sixteen colleges and universities have $500,000 or over of invested funds, and only one half of these have $1,000,000 and over. Now, even the latter sum is a very small endowment for a college; and to call any institution a university which has less than $1,000,000 is to render it absurd in the face of the world. And yet more than one hundred of our institutions, many of them very respectable colleges, have abused the word "university" in this manner. It is to be hoped that the endowment of the more respectable of these institutions may be increased, as many of them deserve

it; and their unfortunate appellation has probably been repented of long since.

But what shall we think of a community that gives the charter of a university to an institution with a total of $20,000 endownment, two so-called professors, and eighteen students; or another with three professors, twelve students, and a total of $27,000 endowment, mostly invested in buildings! And yet there are very many similar institutions; there being sixteen with three professors or less, and very many indeed with only four or five.

Such facts as these could only exist in a democratic country, where pride is taken in reducing everything to a level. And I may also say that it can only exist in the early days of such a democracy; for an intelligent public will soon perceive that calling a thing by a wrong name does not change its character, and that truth, above all things, should be taught to the youth of the nation.

It may be urged that all these institutions are doing good work in education; and that many young men are thus taught who could not afford to go to a true college or university. But I do not object to the education—though I have no doubt an investigation would disclose equal absurdities here—for it is aside from my object. But I do object to lowering the ideals of the youth of the country. Let them know that they are attending a school, and not a university; and let them know that above them comes the college, and above that the university. Let them be taught that they are only half-educated, and that there are persons in the world by whose side they are but atoms. In other words, let them be taught the truth.

It may be that some small institutions are of high grade, especially those which are new; but who can doubt that more than two thirds of our institutions calling themselves colleges and universities are unworthy of the name? Each one of these institutions has so-called professors, but it is evident that they can be only of the grade of teachers. Why should they not be so called? The position of teacher is an honored one, but is not made more honorable by the assumption of a false title. Furthermore, the multiplication of the title and the ease with which it can be obtained render it scarcely worth striving for. When the man of energy, ability, and perhaps genius, is rewarded by the same title and emoluments as the commonplace man with the modicum of knowledge, who takes to teaching, not because of any aptitude for his work, but possibly because he has not the energy to compete with his fellow-men in business, then I say one of the inducements for first-class men to become professors is gone.

When work and ability are required for the position, and when the professor is expected to keep up with the progress of his subject, and to do all in his power to advance it, and when he is selected for these reasons, then the position will be worth working for, and the successful competitor will be honored accordingly. The chivalric spirit

which prompted Faraday to devote his life to the study of nature may actuate a few noble men to give their lives to scientific work; but, if we wish to cultivate this highest class of men in science, we must open a career for them worthy of their efforts.

Jenny Lind, with her beautiful voice, would have cultivated it to some extent in her native village; yet who would expect her to travel over the world, and give concerts for nothing? and how would she have been able to do so if she had wished? And so the scientific man, whatever his natural talents, must have instruments and a library, and a suitable and respectable salary to live upon, before he is able to exert himself to his full capacity. This is true of advance in all the higher departments of human learning, and yet something more is necessary. It is not those in this country who receive the largest salary, and have positions in the richest colleges, who have advanced their subject the most: men receiving the highest salaries, and occupying the professor's chair, are to-day doing absolutely nothing in pure science, but are striving by the commercial applications of their science to increase their already large salary. Such pursuits, as I have said before, are honorable in their proper place; but the duty of a professor is to advance his science, and to set an example of pure and true devotion to it which shall demonstrate to his students and the world that there is something high and noble worth living for. Money-changers are often respectable men, and yet they were once severely rebuked for carrying on their trade in the court of the temple.

Wealth does not constitute a university, buildings do not: it is the men who constitute its faculty, and the students who learn from them. It is the last and highest step which the mere student takes. He goes forth into the world, and the height to which he rises has been influenced by the ideals which he has consciously or unconsciously imbibed in his university. If the professors under whom he has studied have been high in their profession, and have themselves had high ideals; if they have considered the advance of their particular subject their highest work in life, and are themselves honored for their intellect throughout the world—the student is drawn toward that which is highest, and ever after in life has high ideals. But if the student is taught by what are sometimes called good teachers, and teachers only, who know little more than the student, and who are often surpassed and even despised by him, no one can doubt the lowered tone of his mind. He finds that by his feeble efforts he can surpass one to whom a university has given its highest honor; and he begins to think that he himself is a born genius, and the incentive to work is gone. He is great by the side of the mole-hill, and does not know any mountain to compare himself with.

A university should not only have great men in its faculty, but have numerous minor professors and assistants of all kinds, and should

encourage the highest work, if for no other reason than to encourage the student to his highest efforts.

But, assuming that the professor has high ideals, wealth such as only a large and high university can command is necessary to allow him the fullest development.

And this is specially so in our science of physics. In the early days of physics and chemistry, many of the fundamental experiments could be performed with the simplest apparatus. And so we often find the names of Wollaston and Faraday mentioned as needing scarcely anything for their researches. Much can even now be done with the simplest apparatus; and nobody, except the utterly incompetent, need stop for want of it. But the fact remains, that one can only be free to investigate in all departments of chemistry and physics, when he not only has a complete laboratory at his command, but a friend to draw on for the expenses of each experiment. That simplest of the departments of physics, namely, astronomy, has now reached such perfection that nobody can expect to do much more in it without a perfectly equipped observatory; and even this would be useless without an income sufficient to employ a corps of assistants to make the observations and computations. But, even in this simplest of physical subjects, there is great misunderstanding. Our country has very many excellent observatories: and yet little work is done in comparison, because no provision has been made for maintaining the work of the observatory; and the wealth which, if concentrated, might have made one effective observatory which would prove a benefit to astronomical science, when scattered among a half-dozen, merely furnishes telescopes for the people in the surrounding region to view the moon with. And here I strike the key-note of at least one need of our country, if she would stand well in science. . . .

Americans have shown no lack of invention in small things; and the same spirit, when united to knowledge and love of science, becomes the spirit of research. The telegraph operator, with his limited knowledge of electricity and its laws, naturally turns his attention to the improvement of the only electrical instrument he knows anything about; and his researches would be confined to the limited sphere of his knowledge, and to the simple laws with which he is acquainted. But as his knowledge increases, and the field broadens before him, as he studies the mathematical theory of the subject, and the electromagnetic theory of light loses the dim haze due to distance and becomes his constant companion, the telegraph instrument becomes to him a toy, and his effort to discover something new becomes research in pure science.

It is useless to attempt to advance science until one has mastered the science: he must step to the front before his blows can tell in the strife. Furthermore, I do not believe anybody can be thorough in any department of science without wishing to advance it. In the study of

what is known, in the reading of the scientific journals, and the discussions therein contained of the current scientific questions, one would obtain an impulse to work, even though it did not before exist. And the same spirit which prompted him to seek what was already known would make him wish to know the unknown. And I may say that I never met a case of thorough knowledge in my own science, except in the case of well-known investigators. I have met men who talked well, and I have sometimes asked myself why they did not do something; but further knowledge of their character has shown me the superficiality of their knowledge. I am no longer a believer in men who could do something if they would, or would do something if they had a chance. They are impostors. If the true spirit is there, it will show itself in spite of circumstances.

As I remarked before, the investigator in pure science is usually a professor. He must teach as well as investigate. It is a question which has been discussed in late years as to whether these two functions would better be combined in the same individual, or separated. It seems to be the opinion of most that a certain amount of teaching is conducive, rather than otherwise, to the spirit of research. I myself think that this is true, and I should myself not like to give up my daily lecture. But one must not be overburdened. I suppose that the true solution, in many cases, would be found in the multiplication of assistants, not only for the work of teaching, but of research. Some men are gifted with more ideas than they can work out with their own hands, and the world is losing much by not supplying them with extra hands. Life is short: old age comes quickly, and the amount one pair of hands can do is very limited. What sort of shop would that be, or what sort of factory, where one man had to do all the work with his own hands? It is a fact in nature, which no democracy can change, that men are *not* equal—that some have brains, and some hands. And no idle talk about equality can ever subvert the order of the universe.

I know of no institution in this country where assistants are supplied to aid directly in research. Yet why should it not be so? And even the absence of assistant professors and assistants of all kinds to aid in teaching is very noticeable, and must be remedied before we can expect much.

There are many physical problems, especially those requiring exact measurements, which can not be carried out by one man, and can only be successfully attacked by the most elaborate apparatus, and with a full corps of assistants. Such are Regnault's experiments on the fundamental laws of gases and vapors, made thirty or forty years ago by aid from the French Government, and which are the standards to this day. Although these experiments were made with a view to the practical calculation of the steam-engine, yet they were carried out in such a broad spirit that they have been of the greatest theoretical use.

Again, what would astronomy have done without the endowments of observatories? By their means, that science has become the most perfect of all branches of physics, as it should be from its simplicity. There is no doubt in my mind that similar institutions for other branches of physics, or, better, to include the whole of physics, would be equally successful. A large and perfectly equipped physical laboratory, with its large revenues, its corps of professors and assistants, and its machine-shop for the construction of new apparatus, would be able to advance our science quite as much as endowed observatories have astronomy. But such a laboratory should not be founded rashly. The value will depend entirely on the physicist at its head, who has to devise the plan, and to start it into practical working. Such a man will always be rare, and can not always be obtained. After one had been successfully started, others could follow; for imitation requires little brains.

One could not be certain of getting the proper man every time, but the means of appointment should be most carefully studied, so as to secure a good average. There can be no doubt that the appointment should rest with a scientific body capable of judging the highest work of each candidate.

Should any popular element enter, the person chosen would be either of the literary-scientific order, or the dabbler on the outskirts who presents his small discoveries in the most theatrical manner. What is required is a man of depth, who has such an insight into physical science that he can tell when blows will best tell for its advancement.

Such a grand laboratory as I describe does not exist in the world at present for the study of physics. But no trouble has ever been found in obtaining means to endow astronomical science. Everybody can appreciate to some extent the value of an observatory; as astronomy is the simplest of scientific subjects, and has very quickly reached a position where elaborate instruments and costly computations are necessary to further advance. The whole domain of physics is so wide that workers have hitherto found enough to do. But it can not always be so, and the time has even now arrived when such a grand laboratory should be founded. Shall our country take the lead in this matter, or shall we wait for foreign countries to go before? They will be built in the future, but when and how is the question.

Several institutions are now putting up laboratories for physics. They are mostly for teaching, and we can expect only a comparatively small amount of work from most of them. But they show progress; and, if the progress be as quick in this direction as in others, we should be able to see a great change before the end of our lives.

As stated before, men are influenced by the sympathy of those with whom they come in contact. It is impossible to immediately

change public opinion in our favor; and, indeed, we must always seek to lead it, and not be guided by it. For pure science is the pioneer who must not hover about cities and civilized countries, but must strike into unknown forests, and climb the hitherto inaccessible mountains which lead to and command a view of the promised land—the land which science promises us in the future; which shall not only flow with milk and honey, but shall give us a better and more glorious idea of this wonderful universe. We must create a public opinion in our favor, but it need not at first be the general public. We must be contented to stand aside, and see the honors of the world for a time given to our inferiors; and must be better contented with the approval of our own consciences, and of the very few who are capable of judging our work, than of the whole world besides. Let us look to the other physicists, not in our own town, not in our own country, but in the whole world, for the words of praise which are to encourage us, or the words of blame which are to stimulate us to renewed effort. For what to us is the praise of the ignorant? Let us join together in the bonds of our scientific societies, and encourage each other, as we are now doing, in the pursuit of our favorite study; knowing that the world will some time recognize our services, and knowing, also, that we constitute the most important element in human progress.

But danger is also near, even in our societies. When the average tone of the society is low, when the highest honors are given to the mediocre, when third-class men are held up as examples, and when trifling inventions are magnified into scientific discoveries, then the influence of such societies is prejudicial. A young scientist attending the meetings of such a society soon gets perverted ideas. To his mind, a mole-hill is a mountain, and the mountain a mole-hill. The small inventor or the local celebrity rises to a greater height, in his mind, than the great leader of science in some foreign land. He gauges himself by the mole-hill, and is satisfied with his stature; not knowing that he is but an atom in comparison with the mountain, until, perhaps, in old age, when it is too late. But, if the size of the mountain had been seen at first, the young scientist would at least have been stimulated in his endeavor to grow.

We can not all be men of genius; but we can, at least, point them out to those around us. We may not be able to benefit science much ourselves; but we can have high ideals on the subject, and instill them into those with whom we come in contact. For the good of ourselves, for the good of our country, for the good to the world, it is incumbent on us to form a true estimate of the worth and standing of persons and things, and to set before our own minds all that is great and good and noble, all that is most important for scientific advance, above the mean and low and unimportant.

It is very often said that a man has a right to his opinion. This

might be true for a man on a desert island, whose error would influence only himself. But when he opens his lips to instruct others, or even when he signifies his opinions by his daily life, then he is directly responsible for all his errors of judgment or fact. He has no right to think a mole-hill as big as a mountain, nor to teach it, any more than he has to think the world flat, and teach that it is so. The facts and laws of our science have *not* equal importance, neither have the men who cultivate the science achieved equal results. One thing is greater than another, and we have no right to neglect the order. Thus shall our minds be guided aright, and our efforts be toward that which is the highest.

Then shall we see that no physicist of the first class has ever existed in this country, that we must look to other countries for our leaders in that subject, and that the few excellent workers in our country must receive many accessions from without before they can constitute an American science, or do their share in the world's work. . . .

We call this a free country, and yet it is the only one where there is a direct tax upon the pursuit of science. The low state of pure science in our country may possibly be attributed to the youth of the country; but a direct tax, to prevent the growth of our country in that subject, can not be looked upon as other than a deep disgrace. I refer to the duty upon foreign books and periodicals. In our science, no books above elementary ones have ever been published, or are likely to be published, in this country; aud yet every teacher in physics must have them, not only in the college-library, but on his own shelves, and must pay the Government of this country to allow him to use a portion of his small salary to buy that which is to do good to the whole country. All freedom of intercourse which is necessary to foster our growing science is thus broken off; and that which might, in time, relieve our country of its mediocrity is nipped in the bud by our Government, which is most liberal when appealed to directly on scientific subjects. One would think that books in foreign languages might be admitted free; but, to please the half-dozen or so workmen who reprint German books, not scientific, our free intercourse with that country is cut off. Our scientific associations and societies must make themselves heard in this matter, and show those in authority how the matter stands. . . .

THE REMEDIES OF NATURE.

By FELIX L. OSWALD, M. D.

THE ALCOHOL-HABIT (*concluded*).

II.

BUT, in tracing the causes which led to the present development of the poison-vice, we should not overlook the working of another principle which I must call a reaction against the effect of a wrong remedy. We can not serve our cause by ignoring its weak points, for, if we persist in closing our eyes to the significance of our mistakes, our enemies will not fail to profit by our blindness. We can not work in the dark. In order to reach our goal, we must see our way clear; and I trust that no earnest fellow-laborer will misconstrue my motive if I dare to say the whole truth.

The matter is this: At a time when the civilization of antiquity had become extremely corrupt, a society of ethical reformers tried to find the panacea for vice, as we now seek the remedy for intemperance. But, instead of recognizing the local causes of the evil, they ascribed it to the general perversity of the human heart. They, too, failed to distinguish between natural appetites and morbid appetencies, and, misled by the glaring consequences of perverted passions, they conceived the unhappy idea that man's natural instincts are his natural enemies. In order to crush a few baneful nightshades and poppy-blossoms, they began a war of extermination against the flowers of this earth. But that attempt led to an unexpected result: the soil of the trampled fields engendered weeds that were far harder to destroy than the noxious herbs of the old flower-garden. The would-be reformers had overlooked the fact that it is easier to pervert than to suppress a natural instinct; but the history of the last twelve hundred years has illustrated that truth by many dreadful examples. The suppression of rational freedom led to anarchy. Celibacy became the mother of the ugliest vices. The attempt to suppress the pursuit of natural science led to the pursuit of pseudo-science—astrology, necromancy, and all sorts of dire chimeras. The suppression of harmless pleasures has always fostered the *penchant* for vicious pleasures. The austerity of the Stoics helped to propagate the doctrines of Epicurus; in Islam the era of the Hanbalite ascetics was followed by the riots of the Bagdad caliphate; and the open licentiousness of the English anti-Puritans, as well as the secret excesses of their northern neighbors, can be distinctly traced to the mistaken zeal of the party which had waged a long and unrelenting war against every form of physical pleasure, and hoped to find salvation in the suppression of all natural desires. That doctrine has never become the permanent faith of any Aryan nation, though now and then it has reached a local ascendency which

made it a grievous addition to the evils it proposed to cure. More than fifteen hundred years ago the Emperor Julian, and even St. Clemens Alexandrinus, denounced the absurdities of the Marcionite Gnostics, who "abstained from marriage, the pursuit of worldly advantages, and all temporal pleasures." The original rigor of those dogmas could not maintain itself against the healthier instincts of mankind; but what they lost in consistency they made up in aggressiveness: an influential sect of the last century attempted to enforce upon others what the Marcionites practiced in private, and, while the Syrian ascetics preferred the desert to the world, the Scotch ascetics tried to turn the world into a desert.

"According to that code," says the author of the "History of Civilization," "all the natural affections, all social pleasures, all amusements, and all the joyous instincts of the human heart, were sinful. They looked on all comforts as wicked in themselves, merely because they were comforts. The great object in life was to be in a state of constant affliction; . . . whatever pleased the senses was to be suspected. It mattered not what a man liked; the mere fact of his liking it made it sinful. Whatever was natural was wrong. It was wrong to take pleasure in beautiful scenery, for a pious man had no concern with such matters. On Sunday it was sinful to walk in the fields, or in the meadows, or enjoy fair weather by sitting at the door of your own house."

"Whatever was natural was wrong"—though even the extremists of that school might have shrunk from the consistency of their Syrian exemplar, who forbade his anchorites to sleep twice under the same tree, lest their spiritual interests should be imperiled by an undue affection for any earthly object!

If it were possible that such dogmas could ever again overpower the common sense of mankind, we should welcome the poison-mania as the lesser evil, for it is better to seek happiness by a wrong road than to abandon the search altogether. It is better to taste a forbidden fruit than to destroy all pleasant trees. But it is impossible that such chimeras should have survived their native night. After the terrible experience of the middle ages, it is impossible that any sane person should fail to recognize the significance of the mistake, and we can not hope to maintain the field against the opponents of temperance till we have deprived them of their most effective weapon: we must furnish practical proofs that they, not we, are the enemies of human happiness; that we make war upon vice, and not upon harmless pleasures.

It is a significant fact that in every civilized country of this earth drunkenness is rarest among the classes who have other and better convivial resources. In the United States, where the "almighty dollar" confers unlimited privileges, the well-to-do people are the most temperate in the world, the poor the most intemperate. In Turkey, where the lower classes are indulged in many pastimes which are considered

below the dignity of an *effendi*, the poison-vice is actually confined to the upper-ten: temperance reigns in the cottage, while opium-smoking and secret dram-drinking prevail in the palace. In Scotland, where all classes have to conform to the moral by-laws which discountenance holiday recreations, total abstinence is extremely rare. For—"Nature will have her revenge, and, when the most ordinary and harmless recreations are forbidden as sinful, is apt to seek compensation in indulgences which no moralist would be willing to condone. The charge brought against the Novatians in the early ages of the Church can, with equal plausibility, be brought against the Puritans in our own day. One vice, at all events, which Christians of every school, as well as non-Christian moralists, are agreed in condemning, is reputed to be a special opprobrium of Scotland; and the strictest observance of all those minute and oppressive Sabbatarian regulations to which we referred just now has been found compatible with consecrating the day of rest to a quiet but unlimited assimilation of the liquid which inebriates but does not cheer. And under the old *régime* to be drunk in private, though of course not sanctioned as allowable, would have been accounted a far less heinous outrage on the dignity of the Sabbath than to whistle in the public street."—(The "Saturday Review," July 19, 1879, p. 75.)

There is, indeed, no doubt that the "snuffling, whining saints, who groaned in spirit at the sight of Jack in the Green,"* have driven as many pleasure-seekers from the play-ground to the pot-house as despotism has turned freemen into outlaws and robbers. For the practical alternative is not between conventicles and rum-riots, but between healthful and baneful pastimes. Before we can begin to eradicate the poison-habit we must make reform more attractive than vice; and, as long as the champions of temperance shut their eyes to the significance of that truth, their legislative enactments will always remain dead-letter laws. Our worst defects we owe, in fact, less to the shrewdness of our beer-brewing opponents than to the blindness of our Sabbatarian allies. A free Sunday-garden, with zoölogical curiosities, foot-races, and good music, would do more to promote the cause of temperance than a whole army of Hudibras revivalists.†

* Macaulay's "History," vol. i, p. 371.

† "Every one who considers the world as it really exists, and not as it appears in the writings of ascetics and sentimentalists, must have convinced himself that, in great towns, where multitudes of men of all classes and all characters are massed together, and where there are innumerable strangers, separated from all domestic ties and occupations, public amusements of an exciting order are absolutely necessary, and that, while they are often the vehicle and the occasion of evil, to suppress them, as was done by the Puritans of the Commonwealth, is simply to plunge an immense portion of the population into the lowest depths of vice."—(Lecky, "History of Rationalism," vol. ii, p. 286 (*cf.* ibid., vol. ii, p. 350.)

"Sir," said Johnson, "I am a great friend to public amusements, for they keep people from vice."—("Boswell," p. 171.)

"Insani fugiunt mundum, immundumque sequuntur."—Giordano Bruno (Moriz Carrière, "Weltanschauung," p. 396).

Individuals, too, should be treated on that plan, and, next to absolute abstinence from stimulating poisons, the most essential condition of a permanent cure is *a liberal allowance of healthful stimulants*, in the form of diverting pastimes and out-door exercise. For the chief danger of a relapse is not the attractiveness of intoxication, but the misery of the after-effect, the depressing reaction that follows upon the abnormal excitement, and for several weeks seems daily to gain strength against the reformatory resolves of the penitent. This apathy of the unstimulated system can become more intolerable than positive pain, and embitter existence till, in spite of prayers and pledges, its victims either relapse into alcohol or resort to cognate stimulants—chloral, absinthe, or opium. In stress of such temptations the prophylactic influence of a *mind-stimulating occupation* is almost as effective as is the *deliquium* of disappointed love. *Ennui* is the chief coadjutor of the poison-fiend. On the *Militär-Grenze*, the "Military Frontier" of Eastern Austria, a soldier's life is a ceaseless guerrilla-war against smugglers, outlaws, and Bulgarian bed-bugs; yet hundreds of German officers solicit transfer to that region as to a refuge from the temptations of garrison tedium, deliberately choosing a concentration of all discomforts, as a *Schnapps-Kur*, a whisky-cure, as they express it with frank directness; and for similar purposes many of Fremont's contemporaries took the prairie-trail to the adventure-land of the far West. Frederick Gerstaecker found that the California rum-shops got their chief patronage from unsuccessful miners; the successful ones had better stimulants.

For the first month or two the convalescent should not content himself with negative safeguards, but make up his mind that temptations will come, and come in the most grievous form, and that active warfare is nearly always the safest plan. The alcohol-habit is a physical disease, and a Rocky Mountain excursion, a visit to the diggings, a month of sea-side rambles and surf-baths, will do more to help a convert across the slough of despond than a season-ticket to all the lecture-halls of the Christian Temperance Union.

But such excursions should be undertaken in company. Soldiers in the ranks will endure hardships that would melt the valor of any solitary hero; and in the presence of manly companions the spirit of emulation and "approbativeness" will sustain even an enervated fellow. The *esprit de corps* of a temperance society is more cogent than its vows.

An *appeal to the passions* is the next best thing. Everything is fair in the war against alcohol: love, ambition, pride, and even acquisitiveness, may be utilized to divert the mind from a more baneful propensity—for a time, at least. For, after the tempter has been kept at bay for a couple of months, its power will reach a turning-point; the nervous irritability will subside, the outraged digestive organs resume their normal functions, and the potency of the *poison-*

hunger will decrease from day to day. After that the main point is to gain time, and give Nature a fair chance to complete the work of redemption. As the *vis vitæ* recovers her functional vigor the employment of other tonics can be gradually dispensed with, except in the moments of unusual dejection that will now and then recur—especially on rainy days and after sultry nights. But in most such cases the demon can be exorcised with the price of an opera-ticket, and not rarely with *a liberal dinner*. "Good cheer" is a suggestive term; the mess, as well as music, has power to soothe the savage soul, and, before invoking the aid of medicinal tonics, Bibulus should try the dulcifying effect of digestible sweetmeats.

But, on the other hand, when luck and high spirits give a sufficient guarantee against present temptation, no opportunity should be missed to forego a meal. *Fasting* is a great system-renovator. Ten fast-days a year will purify the blood and eradicate the *poison-diathesis* more effectually than a hundred bottles of expurgative bitters.

And only then, after the paroxysmal phase of the baneful passion has been fairly mastered, moral suasion gets a chance to promote the work of reform. For, while the delirium or the crazing after-effects of the alcohol-fever distract the patient, exhortations are as powerless as they would be against chronic dysentery. Dr. Isaac Jennings illustrates the power of the poison-habit by the following examples: A clergyman of his acquaintance attempted to dissuade a young man of great promise from habits of intemperance. "Hear me first a few words," said the young man, "and then you may proceed. I am sensible that an indulgence in this habit will lead to loss of property, the loss of reputation and domestic happiness, to premature death, and to the irretrievable loss of my immortal soul; and now with all this conviction resting firmly on my mind and flashing over my conscience like lightning, if I still continue to drink, do you suppose anything you can say will deter me from the practice?"

Dr. Mussey, in an address before a medical society, mentioned a case that sets this subject in even a stronger light. A tippler was put into an almshouse in a populous town in Massachusetts. Within a few days he had devised various expedients to procure rum, but failed. At length he hit upon one that proved successful. He went into the wood-shed of the establishment, placed one hand upon a block, and, with an axe in the other, struck it off at a single blow. With the stump raised and streaming, he ran into the house, crying, "Get some rum—get some rum! my hand is off!" In the confusion and bustle of the occasion somebody did bring a bowl of rum, into which he plunged his bleeding arm, then raising the bowl to his mouth, drank freely, and exultingly exclaimed, "Now I am satisfied!"

More than the hunger after bread, more than the frenzy of love or hatred, the poison-hunger overpowers every other instinct, and even the fear of death. In Mexico, my colleague, Surgeon Kellermann, of

the Second Zouaves, was one night awakened by the growling of his spaniel, and thought he saw something like the form of a man crawling out of his tent. The next day the captain informed the company that some fellow had entered the hospital-camp with burglarious intent, and that he had instructed the sentries to arrest or shoot all nocturnal trespassers. About a week after, the doctor was again awakened by his dog, and, lighting a match, he distinguished the figure of a large man crawling from under his table and carrying in his hand a box or a big book. He called upon him to stop, cocking his pistol at the same time, but the fellow made a rush for the door, and in the next moment was floored by a ball that penetrated his skull two inches above the neck. He lived long enough to confess the motive of his desperate enterprise. His regiment had been stationed in Northern Algiers, where he learned to smoke opium, and having exhausted his supply, and his financial resources, as well as the patience of the hospital steward, who had at various times furnished him small doses of the drug, he felt that life was no longer worth living, and resolved to risk it in the attempt at abducting the doctor's medicine chest. What can exhortation avail against a passion of that sort? We should learn to treat it as the advanced stage of a physical disorder, rather than as a controvertible moral aberration.

And, even after the delirium of that disease has subsided, homilies should be preceded by an appeal to reason. Ignorance is a chief cause of intemperance. The seductions of vice would not mislead so many of our young men if they could realize the significance of their mistake. All the efforts of the Temperance party have thus far failed to eradicate the popular fallacy that there is some good in alcohol; that somehow or other the magic of a stimulating drug could procure its votaries an advantage not attainable by normal means. Nor is this delusion confined to the besotted victims of the poison-vice. Even among the enlightened classes of our population, nay, among the champions of temperance, there is still a lingering belief that, with due precaution against excess, adulteration, etc., a dram-drinker might "get ahead" of Nature, and, as it were, *trick* her out of some extra enjoyment.

There is no hope of a radical reform till an influential majority of all intelligent people have realized the fact that this *trick* is in every instance a *losing game*, entailing penalties which far outweigh the pleasures that the novice may mistake for gratuitous enjoyments, and by which the old *habitué* can gain only a temporary and qualified restoration of the happiness which his stimulant has first deprived him of. For the depression of the vital energy increases with every repetition of the stimulation-process, and in a year after the first dose all the "grateful and exhilarating tonics" of our professional poison-vendors can not restore the vigor, the courage, and the cheerfulness which the mere consciousness of perfect health imparts to the total abstainer.

A great plurality of all beginners underrate the difficulty of controlling the cravings of a morbid appetite. They remember that their natural inclinations at first opposed, rather than encouraged, the indulgence; they feel that at the present stage of its development they could abjure the passion and keep their promise without any difficulty. But they overlook the fact that the moral power of resistance decreases with each repetition of the dose, and that the time will come when only the practical impossibility of procuring their wonted tipple will enable them to keep their pledge of total abstinence. It is true that by the exercise of a constant self-restraint a person of great will-force may resist the progressive tendency of the poison-habit and confine himself for years to a single cigar or a single bottle of wine per day. But, if all waste is sinful, is not this constant pull against the stream a wicked misuse of moral energy—a wanton waste of an effort which in less treacherous waters would insure the happiest progress, and propel the boat of life to any desired goal?

But, while temperance people, as a class, are apt to underrate the difficulty of a total cure of a confirmed poison-habit, they generally overrate the difficulty of total prevention. The natural inclination of a young child is in the direction of absolute abstinence from all noxious stimulants. I do not speak only of the children of temperate people who strengthen that inclination by moral precepts, but of drunkards' boys, of the misbegotten cadets of our tenement barracks and slum-alleys. All who will make their disposition a special study may repeat the experiments which have convinced me that the supposed effects of hereditary propensities are in almost every case due to the seductions of a bad example, and that the influence of an innate predisposition has been immoderately exaggerated. Watch the young picnickers of an orphan-festival, and see what a great majority of them will prefer sweet cold milk to iced tea, and the lemonade-pail to the ginger-beer basket. Offer them a glass of liquor, and see how few out of a hundred will be able to sip it without a shudder. Or let us go a step further, and interview the inmates of a house of correction, or of a Catholic "protectory" for young vagrants. The superintendent of a penitentiary for adults (in Cologne, Germany) expressed a conviction that a plurality of his prisoners would stretch out their hands for a bottle of the vilest liquor rather than for a piece of gold. In the house of correction I would stake any odds that ninety per cent of all boy-prisoners under fourteen would prefer an excursion-ticket to a bottle of the best wine of Tokay or Johannisberg. At home, in a preparatory school of all vices, they of course imitate their teachers, but only by overcoming almost the same instinctive repugnance which is the best safeguard of the total abstainer's child. At the *first* attempt even the offspring of a long lineage of drunkards abhors the taste of alcohol as certainly as the child of the most inveterate smoker detests the smell of tobacco.

But it is true that the impaired vitality of the habitual drunkard transmits itself mentally in the form of a peculiar disposition which I have found to be equally characteristic of the children (and even grandchildren) of an opium-eater. They lack that spontaneous gayety which constitutes the almost misfortune-proof happiness of normal children, and, without being positively peevish or melancholy, their spirits seem to be clouded by an apathy which yields only to strong external excitants. But out-door work and healthy food rarely fail to restore the tone of the mind, and even before the age of puberty the manifestations of a more buoyant temper will prove that the patient has outgrown the hereditary hebetude, and with it the need of artificial stimulation. Temptation, of course, should always be guarded against, and also everything that could tend to aggravate the lingering despondency of the convalescent—harsh treatment, solitude, and a monotonous occupation.

With normal children such precautions are superfluous. They will resist temptation if we do not force it upon them. No need of threats and tearful exhortations; you need not warn a boy to abstain from disgusting poisons—Nature attends to that; but simply provide him with a sufficient quantity of palatable, non-stimulating food, till he reaches the age when habit becomes as second nature. It was Rousseau's opinion that a taste for stimulants could be acquired only during the years of immaturity, and that there would be little danger after the twentieth year, if in the mean while observation and confirmed habits had strengthened the protective instincts which Nature has erected as a bulwark between innocence and vice. We need not fortify that bulwark by artificial props, we need not guard it with anxious care; all we have to do is to save ourselves the extraordinary trouble of breaking it down. After a boy becomes capable of inductive reasoning, it can, of course, do no harm to call his attention to the evils of intemperance, and give him an opportunity to observe the successive stages of the alcohol-habit, the gradual progress from beer to brandy, from a "state of diminished steadiness" to delirium tremens. In large cities, where the evils of drunkenness reveal themselves in all their naked ugliness, children can easily be taught to regard the poison-vice as a sort of disease which should be guarded against, like small-pox or leprosy.

But it should always be kept in mind that even the milder stimulant-habits have a progressive tendency, and that under certain circumstances the attempt to resist that bias will overtask the strength of most individuals. According to the allegory of the Grecian myth, the car of Bacchus was drawn by tigers; and it is a significant circumstance that war, famine and pestilence have so often been the forerunners of veritable alcohol-epidemics. The last Lancashire strike was accompanied by whisky riots; the starving Silesian weavers tried to drown their misery in *Schnapps*. In France almost every general de-

cline of material prosperity has been followed by a sudden increase of intemperance, and after a prolonged war the vanquished party seems to be chiefly liable to that additional affliction. The explanation is that, after the stimulant-habit has once been initiated, every unusual depression of mental or physical vigor calls for an increased application of the wonted method of relief. Nations who have become addicted to the worship of a poison-god will use his temple as a place of refuge from every calamity; and children whose petty ailments have been palliated with narcotics, wine, and cordials, will afterward be tempted to drown their deeper sorrow in deeper draughts of the same nepenthe.

And even those who manage to suppress that temptation have to suppress the revivals of a hard-dying hydra, and will soon find that only abstinence from *all* poisons is easier than temperance.

THE AGE OF TREES.

By J. A. FARRER.

SINCE De Candolle, the celebrated Swiss botanist, propagated the idea that a tree has no limits set by nature in its constitution to the term of its existence, the question of the age attainable by trees has never ceased to be debated with considerable interest. De Candolle's argument was to the effect that whereas animals have, by the physiological construction of their vessels, a set limit to the duration of their lives, trees have no such natural termination; and that although their decay and death are so familiar to us that we commonly speak of this or that species as living for a given period like two hundred years, yet such decay is rather the result of accident or disease than of any law inherent in their nature such as in our own case we designate as death by old age. Whence, the same botanist inferred, there is no reason why trees under perfectly favorable conditions should ever perish; and he proceeded to adduce in favor of that theory instances of trees which even then were in the enjoyment of no contemptible moment of eternity.

Until accurate observations have been made for hundreds or perhaps thousands of years, it would seem impossible to arrive at even an approximate solution of so wide a problem as this. Under the best conditions we could never eliminate those causes of tree mortality which De Candolle fairly enough calls accidental, but which are contained in the invariable laws of the elements. The largest, and therefore probably the oldest, trees are the special sport of the lightning; and the storm which has so often felled trees of the most prodigious size will, even if it spare the trunk, break off boughs, thus admitting

at the point of fracture that caries into the trunk which will ultimately reduce it to a mere shell, similar to one of those bull-oaks wherein the bull loves to hide himself. These causes of disease and decay can never be absent, since they evidently belong to the permanent order of nature.

Again, De Candolle accounts with great probability for the diminished rate of tree-growth after a certain period by such considerations as the greater distance of the roots from the air, their coming into contact with the roots of other trees, or with a rocky or otherwise unsuitable substratum, or the diminished elasticity of the bark; and though it is possible that trees might continue to grow in their fifth century at the same rate as in their first, if the conditions remained equally favorable, yet, since the proviso can never be insured, a further difficulty, amounting to insuperability, occurs, to prevent such an hypothesis from being brought to the test of either observation or experiment.

Whether, therefore, a tree might possibly continue living and growing forever is a question of less entertainment than the question of its possible duration in the common state of nature and under the irreversible conditions of climate, soil, and the elements. What age may we ascribe to some of our largest specimens, either still existing or recorded in trustworthy history? Is the period of one thousand years, the favorite figure of tradition, a common or probable period of arboreal longevity, or have our proudest forest giants attained their present size in half the time that is commonly claimed for them?

In the discussion of this question we have but few known data to guide us, since statistics of the rate of growth, as afforded by careful measurement, date only from about the beginning of the eighteenth century. Of such statistics we may dismiss at once measurement of height or of the spread of a tree's boughs, the measurement of girth being far easier and more conclusive. But it is unfortunate that no standard of distance from the ground has yet been adopted for measurement, so that the needless perplexity might be avoided which is derived from giving the circumference now at the ground and now at two, or three, or six feet above it.

The counting of the rings added by exogenous trees every year to their circumferences can only, without risk of great error, be applied to trees cut down in their prime, and hence is useless for the older trees which are hollow and decayed. Trees, moreover, often develop themselves so unequally from their center that, as in the case of a specimen in the museum at Kew, there may be about two hundred and fifty rings on one side to fifty on the other. Perhaps the largest number of rings that has ever been counted was in the case of an oak felled in 1812, where they amounted to seven hundred and ten; but De Candolle, who mentions this, adds that three hundred years were added to this number as probably covering the remaining rings which it was no

longer possible to count. This instance may be taken to illustrate how unsatisfactory this mode of reckoning really is for all but trees of comparatively youthful age.

The external girth measurement is for these reasons the best we can have, being especially applicable where the date of a tree's introduction into a country or of its planting is definitely fixed, since it enables us to argue from the individual specimen or from a number of specimens, not with certainty, but within certain limits of variability, to the rate of growth of that tree as a species. In these measurements of trees of a century or more in age, such as are given abundantly in Loudon's "Arboretum," lies our best guide, though even then the growth in subsequent ages must remain matter of conjecture. The difficulty is to reduce this conjectural quantity to the limits of probability; for, given the ascertained growth of the first century, how shall we estimate the diminished growth of later centuries? The best way would seem to be to take the ascertained growth of the first century, and then to make, say, the third of it the average growth of every century. Thus, if we were to take twelve feet as the ascertained growth of an oak in its first century, four feet would be its constant average rate, and we might conjecture that an oak of forty feet was about a thousand years old. But clearly it might be much less; for the reason for taking the third is not so much that it is a more probable average than the half, as that it is obviously less likely to err on the side of excess of rapidity.

The cypress affords an instance where the approximate certainty of its introduction into England enables us to form some conclusions with regard to its attainable age. The fact of its being first mentioned in Turner's "Names of Herbs," published in 1548, makes it probable that it was not introduced into England before the beginning of that century. But, at all events, the cypress at Fulham, which in 1793 was two feet five inches at three feet from the ground, can not have been planted there before 1674, the year that Compton, the great introducer of foreign trees into England in the seventeenth century, became Bishop of London. That gives a growth of about two feet in the first century; but sometimes it attains a higher rate, as in the case of the cypress planted by Michael Angelo at Chartreux, which was thirteen feet round in 1817, giving the average rate of over four feet in the first three centuries. Now, the cypress at Somma, between Lake Maggiore and Milan, for whose sake Napoleon bent the road out of the straight line, is not more than twenty-three feet in girth, so that the tradition which makes its planting coeval with Christianity would seem doubtful; though if we take three feet as the first century's growth, and take the third as the average, it may evidently have been standing in the time of Cæsar, as an old chronicle of Milan is averred to attest.

The Lebanon cedar first planted at Lambeth in 1683 was only seven

feet nine inches (girth measurements alone need be given) one hundred and ten years later. Dr. Uvedale's cedar, planted at Enfield not earlier than 1670, was fifteen feet eight inches when measured in 1835, i. e., one hundred and sixty-five years afterward. And the large cedar at Uxbridge, which was blown down in 1790, was one hundred and eighteen years old when Gilpin measured it in 1776, and found it to be fifteen feet and a half. We should therefore be justified in assuming twelve feet as the possible first century's growth of a cedar even in England; whence we may test the probability of the oldest cedars now on Mount Lebanon having been growing there in the days of King Solomon. In the year 1696 the traveler Maundrell measured one of the largest of them and found it to be twelve yards six inches. Four feet a century being the average rate, the cedar measured by Maundrell would have required only nine centuries to have attained its dimensions of thirty-six feet; so that it need have been no older than the time of Charlemagne, and, allowing for a more rapid growth on a site where it is indigenous, may probably have been considerably younger.

From the claims to antiquity of the cedars of Lebanon let us pass to those of the Tortworth Spanish chestnut in Gloucestershire, which sometimes boasts to be the oldest tree in England, and bears an inscription to the effect that King John held a Parliament beneath it.* Sir Robert Atkyns, whose history of that county was published in 1712, usually bears the responsibility of connecting the tree with King John; but he only speaks of it as said by tradition "to have been growing there in the reign of King John. It is nineteen yards in compass, and seems to be several trees incorporated together, and young ones are still growing up which may in time be joined to the old body." It was also probably on hearsay evidence that Evelyn spoke of it as standing on record that a chestnut (at Tamworth) formed a boundary tree in the reign of Stephen. We may assume Evelyn to have meant the tree in question; we may pass the hesitation of tradition between two kings not remote from one another in time; and we may accept fifty-seven feet as the maximum measurement, though no subsequent measurement gives so high dimensions. Now, that a chestnut may attain seventeen feet in its first century is proved by the fact that a chestnut at Nettlecombe, planted within the recollection, and therefore within the life, of Sir John Trevelyan, who died in 1828, was over seventeen feet.† But we may be content with fifteen feet for the first century. Then, on the principle of the third as the average, we should require a period of eleven centuries for fifty-seven feet; but that this average would be too low is evident from the fact that in seventy-one years—i. e., between 1766 and 1837—it was proved to have increased two feet in girth. Therefore we should have a diminishing series be-

* Jesse, "Gleanings in Natural History," i, 341.

† Selby, "Forest Trees," 334 (1842).

tween, say, fifteen feet a century at one end and a little over two feet a century at the other. This might be at the following rate, taking each figure for the growth of a century: 15+13+10+8+6+3+2 = 57. By which calculation seven centuries would have been the tree's age when Sir Robert Atkyns declared it to be fifty-seven feet in 1712, an antiquity that would amply satisfy tradition, but could not remove the probability that the tree is not a single trunk, but really a number of different trees that have become incorporated together.

A somewhat similar theory may be applied to the famous *Castagna di Cento Cavalli* on Mount Etna, so called because a Queen of Aragon and one hundred followers on horseback are said to have taken shelter beneath it from a shower of rain. Brydone, in 1790, measured the circumference to be two hundred and four feet, but it seemed to him that the tree in question, of which only separate trunks remain, was really five separate trees; and though he professed to have found no bark on the insides of the stumps nor on the sides opposite to one another, yet a more recent traveler states, in Murray's guide-book, that this is only true of the southernmost stem, and that one of the masses still standing does show bark all round it, which would of course prove it to be a separate tree. Of the other large chestnuts on Etna the *Castagna del Nave* is rather larger than the Tortworth specimen, while the *Castagna della Galea* is seventy-six feet at two feet from the ground. The rich soil of pulverized volcanic ash combined with decomposed vegetable matter probably enabled them to attain their present size within a shorter period than would be implied by such dimensions elsewhere; but whether they are five centuries or ten it is absolutely impossible to conjecture.

The great variability in the rate of growth in trees of the same species is perhaps the most remarkable thing afforded by statistics. We say, for instance, roughly, that the beech grows twice as fast as an oak; but take four beeches mentioned by Loudon, placing their years in one column and their circumference in another:

One in King's County	at	60	years	was	17	feet.
One at Foster Hall	"	100	"	"	12	"
One at Courtachy Castle	"	102	"	"	18	"
One in Callendar Park	"	200	"	"	17	"

So that of three beeches nearly the same in size one was only sixty, another one hundred and two, and another as much as two hundred. And this variability of rate is still more conspicuous in the oak. De Candolle, who counted the rings of several oaks that had been felled, found one that at two hundred years had only the same circumference that another had attained at fifty. Some had grown slowly at first, and then rapidly; others, like bad racers, had begun fast and ended slowly. And even the diminished rate of growth would not seem to be an invariable rule, for one oak of three hundred and thirty-three years was shown to have increased as much between three hundred

and twenty and three hundred and thirty as it had between ninety and one hundred.

This reduces the computation of the age of an oak to little more than guess-work. The Cowthorpe oak, the largest existing in England, reached at one time seventy-eight feet in circumference. Damory's oak, in Dorsetshire, was only ten feet less when it was so decayed that it was cut up and sold for fire-wood in 1755; and the Boddington oak, in the vale of Gloucester, was fifty-four feet at the base when it was burned down in 1790. It is needless to mention other English oaks which are also claimants to a remote antiquity; but it is obvious, from the very variable rate of the growth of oaks, that size establishes no indisputable title, and that the Cowthorpe oak need not therefore be the oldest English oak because it is the largest recorded. From Loudon's statistics of oaks are extracted the following notices of trees, according to their age and girth:

Years.	Feet of circumference.	Years.	Feet of circumference.
40	8	200	7½
83	12	200	25
100	12	201	21
100	18	220	20
100	21	250	19½
120	14	300	33
180	15	330	27

This table not only shows the great variability of growth, but, if we take the three specimens of one hundred years old, gives us the high average of seventeen feet as that of only the first century. Taking, then, as usual, the third as the average growth, we should require rather more than eight centuries for an oak of fifty feet, which reduces to a very small number the oaks in England that can claim a thousand years.

When, therefore, Gilpin, in his "Forest Scenery," speaks of nine hundred years as of no great age for an oak, it must be said that very few oaks can be named which by measurement would sustain their title to that age. Tradition, which is always sentimental, leans naturally to the side of exaggerated longevity. William of Wainfleet gave directions for Magdalen College, Oxford, to be built near the great oak which fell suddenly in the year 1788, and out of which the president's chair was made, in memory of the tree. Gilpin assumes that for the tree to have been called great it must have been five hundred years old, and, therefore, perhaps standing in the time of King Alfred. But it is clear that it need not have been a century old to have fairly earned the title of great, and that, therefore, a period of six centuries may have covered its whole term of existence.

We are certainly apt to underrate the possible rate of growth where a tree meets with altogether favorable conditions. The silver fir was only introduced into England in the seventeenth century by

Sergeant Newdigate; and one tree of his planting was thirteen feet round when Evelyn measured it eighty-one years afterward. A comparison of the statistics of growth, as above collected with reference to the oak, indicates with respect to most trees a more rapid rate than is commonly supposed. Let us test the claims of some of the oldest limes. The Swiss used often to commemorate a victory by planting a lime-tree, so that it may be true that the lime still in the square of Fribourg was planted on the day of their victory over Charles the Bold at Morat in 1476. A youth, they say, bore it as a twig into the town, and arriving breathless and exhausted from the battle had only strength to utter the word "Victory!" before he fell down dead. But this tree was only thirteen feet nine inches in 1831, i. e., three hundred and fifty-five years afterward, and it would be extraordinary if a lime had not attained in that period greater bulk than even an oak might have reached in a century. The large lime at Neustadt, in Würtemberg, mentioned by Evelyn as having its boughs supported by columns of stone, was twenty-seven feet when he wrote (1664), and in 1837 it was fifty-four, so that within a period of one hundred and seventy-three years it had gained as much as twenty-seven feet. Consequently, making allowance for diminished growth, we may fairly assume that two hundred years would have been more than enough for the attainment of the circumference of the first twenty-seven feet which it had reached in the time of Evelyn. No English lime appears to have reached such dimensions as would imply a growth of more than three centuries, though the lime at Depeham, near Norwich, which was forty-six feet when Sir Thomas Browne sent his account of it to Evelyn, sufficiently dispels the legend that all limes in this country have come from two plants brought over by Sir John Spelman, who introduced the manufacture of paper into England from Germany, and to whom Queen Elizabeth granted the manor of Portbridge.

It would be natural to expect the greatest longevity in indigenous trees, and, though it has been much disputed what kinds are native to the English soil, etymology alone would indicate that the following trees were of Roman importation: the elm (*ulmus*), the plane (*platanus*), the poplar (*populus*), the box (*buxus*), the chestnut (*castanea*). The yew, on the contrary, is probably indigenous, though its opponents find some reason for their skepticism in the fact that its larger specimens are chiefly found in church-yards and artificial plantations. In favor of its claim is the fact that its pretensions to longevity seem to be better founded than those of any other English tree, not even excluding the oak. A yew that was dug up from a bog in Queen's County was proved by its rings to have been five hundred and forty-five years of age; yet for the last three hundred years of its life it had grown so slowly that near the circumference one hundred rings were traceable within an inch. Some great and sudden change for the worse

in the external conditions may have accounted for so slow a rate; but it would hardly be safe, with such evidence before us, to allow more than three feet a century as the normal growth of a yew, in which case the Fortingal yew in Scotland, fifty-six feet round in 1769, may have lived more than eighteen centuries; and a longevity in proportion must be accorded to the yews at Fountain's Abbey, or to the Tisbury yew in Dorsetshire, which boasts of thirty-seven feet in circumference. Hence tradition in this case would seem to contain nothing incredible when it asserts that the yews on Kingley Bottom, near Chichester, were on their present site when the sea-kings from the North landed on the coast of Sussex.

It is, however, but seldom that any real aid can be derived from tradition in estimating the longevity of trees. We have even to be on our guard against it, especially when it associates the general claim to antiquity by a specific name or event. In the classical period the tendency was as strong as it is still; and we should look to our own legends when tempted to smile at the Delian palm mentioned by Pliny as coeval with Apollo, or at the two oaks at Heraclea as planted by Hercules himself. Pausanias, traveling in Greece in the second century of our era, saw a plane-tree which was said to have been planted by Menelaus when collecting forces for the Trojan war, whence Gilpin gravely inferred that the tree must have been thirteen centuries old when Pausanias saw it. Tacitus calculated that a fig-tree was eight hundred and forty years old because tradition accounted it the tree whereunder the wolf nursed Romulus and Remus. Nor was Pliny's inference more satisfactory, that three hollies still standing in his day on the site of Tibur must have been older than Rome itself, inasmuch as Tibur was older than Rome, and they were the very trees on which Tiburtus, the founder of the former, saw the flight of birds descend which decided him on the site of his city. There is of course no more reason to believe in the reality of Tiburtus than of Francion, the mythical forefather of France, or of Brute the Trojan, the reputed founder of the British Empire.

These things suffice to justify suspicion of trees associated with particular names, such as Wallace's Oak, or trees claiming to have been planted by St. Dominic or Thomas Aquinas. Our only safe guide is measurement, applied year by year to trees alike of known and of unknown age, of insignificant as of vast dimensions, and recorded in some central annual of botanical information, facilitating the work of comparison and the arrival at something like trustworthy averages. The experiment, moreover, has not been sufficiently tried whether our oldest trees are capable of an increased rate of growth by the application of fresh earth round their roots, favorable though the case of the Tortworth chestnut is to the probability of such a result. Until, therefore, such statistics are more numerous than at present, we must be content to rest in the uncertainty with regard to the ages of trees which the

preceding attempt to estimate them makes sufficiently manifest, and to arrive at no more definite conclusion than was long ago arrived at by Pliny, that "vita arborum quarundam immensa credi potest" ("The life of some trees may be believed to be prodigious").—*Longman's Magazine.*

SOME UNSOLVED PROBLEMS IN GEOLOGY.*

By Dr. J. W. DAWSON.

II.

AGAIN: we are now prepared to say that the struggle for existence, however plausible as a theory, when put before us in connection with the productiveness of animals, and the few survivors of their multitudinous progeny, has not been the determining cause of the introduction of new species. The periods of rapid introduction of new forms of marine life were not periods of struggle, but of expansion—those periods in which the submergence of continents afforded new and large space for their extension and comfortable subsistence. In like manner it was continental emergence that afforded the opportunity for the introduction of land animals and plants. Further, in connection with this, it is now an established conclusion that the great aggressive faunas and floras of the continent have originated in the north, some of them within the Arctic Circle; and this in periods of exceptional warmth, when the perpetual summer sunshine of the Arctic regions co-existed with a warm temperature. The testimony of the rocks thus is, that not struggle, but expansion, furnished the requisite conditions for new forms of life, and that the periods of struggle were characterized by depauperation and extinction.

But we are sometimes told that organisms are merely mechanical, and that the discussions respecting their origin have no significance, any more than if they related to rocks or crystals, because they relate merely to the organism considered as a machine, and not to that which may be supposed to be more important, namely, the great determining power of mind and will. That this is a mere evasion, by which we really gain nothing, will appear from a characteristic extract of an article by an eminent biologist, in the new edition of the "Encyclopædia Britannica"—a publication which, I am sorry to say, instead of its proper *rôle* as a repertory of facts, has become a strong partisan, stating extreme and unproved speculations as if they were conclusions of science. The statement referred to is as follows: "A mass of living protoplasm is simply a molecular machine of great complexity, the total results of the working of which, or its vital phenomena,

* Address of the President of the American Association for the Advancement of Science, delivered at Minneapolis, August 15, 1883. Reprinted from "Science."

depend on the one hand on its construction, and, on the other, on the energy supplied to it; and to speak of vitality as anything but the name for a series of operations is as if one should talk of the horologity of a clock." It would, I think, scarcely be possible to put into the same number of words a greater amount of unscientific assumption and unproved statement than in this sentence. Is "living protoplasm" different in any way from dead protoplasm, and, if so, what causes the difference? What is a "machine"? Can we conceive of a self-produced or uncaused machine, or one not intended to work out some definite results? The results of the machine in question are said to be "vital phenomena"; certainly most wonderful results, and greater than those of any machine man has yet been able to construct! But why "vital"? If there is no such thing as life, surely they are merely physical results. Can mechanical causes produce other than physical effects? To Aristotle, life was "the cause of form in organisms." Is not this quite as likely to be true as the converse proposition? If the vital phenomena depend on the "construction" of the machine, and the "energy supplied to it," whence this construction, and whence this energy? The illustration of the clock does not help us to answer this question. The construction of the clock depends on its maker, and its energy is derived from the hand that winds it up. If we can think of a clock which no one has made and which no one winds—a clock constructed by chance, set in harmony with the universe by chance, wound up periodically by chance—we shall then have an idea parallel to that of an organism living, yet without any vital energy or creative law; but in such a case we should certainly have to assume some antecedent cause, whether we call it "horologity" or by some other name. Perhaps the term "evolution" would serve as well as any other, were it not that common sense teaches that nothing can be spontaneously evolved out of that in which it did not previously exist.

There is one other unsolved problem, in the study of life by the geologist, to which it is still necessary to advert. This is the inability of paleontology to fill up the gaps in the chain of being. In this respect, we are constantly taunted with the imperfection of the record; but facts show that this is much more complete than is generally supposed. Over long periods of time and many lines of being, we have a nearly continuous chain; and, if this does not show the tendency desired, the fault is as likely to be in the theory as in the record. On the other hand, the abrupt and simultaneous appearance of new types in many specific and generic forms, and over wide and separate areas at one and the same time, is too often repeated to be accidental. Hence paleontologists, in endeavoring to establish evolution, have been obliged to assume periods of exceptional activity in the introduction of species, alternating with others of stagnation—a doctrine differing very little from that of special creation as held by the older geologists.

The attempt has lately been made to account for these breaks by the assumption that the geological record relates only to periods of submergence, and gives no information as to those of elevation. This is manifestly untrue. In so far as marine life is concerned, the periods of submergence are those in which new forms abound for very obvious reasons already hinted. But the periods of new forms of land and fresh-water life are those of elevation, and these have their own records and monuments, often very rich and ample; as, for example, the swamps of the carboniferous, the transition from the cretaceous subsidence to the Laramie elevation, the tertiary lake-basins of the West, the terraces and raised beaches of the pleistocene. Had I time to refer in detail to the breaks in the continuity of life, which can not be explained by the imperfection of the record, I could show at least that nature, in this case, does advance *per saltum*—by leaps, rather than by a slow, continuous process. Many able reasoners, as Le Conte in this country, and Mivart and Collard in England, hold this view.

Here, as elsewhere, a vast amount of steady conscientious work is required to enable us to solve the problems of the history of life. But, if so, the more the hope for the patient student and investigator. I know nothing more chilling to research, or unfavorable to progress, than the promulgation of a dogmatic decision that there is nothing to be learned but a merely fortuitous and uncaused succession, amenable to no law, and only to be covered, in order to hide its shapeless and uncertain proportions, by the mantle of bold and gratuitous hypothesis.

So soon as we find evidence of continents and oceans, we raise the question, "Have these continents existed from the first in their present position and form, or have the land and water changed places in the course of geological time?" In reality both statements are true in a certain limited sense. On the one hand, any geological map whatever suffices to show that the general outline of the existing land began to be formed in the first and oldest crumplings of the crust. On the other hand, the greater part of the surface of the land consists of marine sediments which must have been derived from land that has perished in the process, while all the continental surfaces, except, perhaps, some high peaks and ridges, have been many times submerged. Both of these apparently contradictory statements are true; and, without assuming both, it is impossible to explain the existing contours and reliefs of the surface.

In the case of North America, the form of the old nucleus of Laurentian rock in the north already marks out that of the finished continent, and the successive later formations have been laid upon the edges of this, like the successive loads of earth dumped over an embankment. But, in order to give the great thickness of the palæozoic sediments, the land must have been again and again submerged, and for long periods of time. Thus, in one sense, the continents have been fixed;

in another, they have been constantly fluctuating. Hall and Dana have well illustrated these points in so far as Eastern North America is concerned. Professor Hull, of the Geological Survey of Ireland, has recently had the boldness to reduce the fluctuations of land and water, as evidenced in the British Islands, to the form of a series of maps intended to show the physical geography of each successive period. The attempt is probably premature, and has been met with much adverse criticism; but there can be no doubt that it has an element of truth. When we attempt to calculate what could have been supplied from the old eozoic nucleus by decay and aqueous erosion, and when we take into account the greater local thickness of sediments toward the present sea-basins, we can scarcely avoid the conclusion that extensive areas once occupied by high land are now under the sea. But to ascertain the precise areas and position of these perished lands may now be impossible.

In point of fact, we are obliged to believe in the contemporaneous existence in all geological periods, except perhaps the very oldest, of three sorts of areas on the surface of the earth: 1. Oceanic areas of deep sea, which must always have occupied the bed of the present ocean, or parts of it; 2. Continental plateaus, sometimes existing as low flats or as higher table-lands, and sometimes submerged; 3. Areas of plication or folding, more especially along the borders of the oceans, forming elevated lands rarely submerged, and constantly affording the material of sedimentary accumulations.

Every geologist knows the contention which has been occasioned by the attempts to correlate the earlier palæozoic deposits of the Atlantic margin of North America with those forming at the same time on the interior plateau, and with those of intervening lines of plication and igneous disturbance. Stratigraphy, lithology, and fossils are all more or less at fault in dealing with these questions; and, while the general nature of the problem is understood by many geologists, its solution in particular cases is still a source of apparently endless debate.

The causes and mode of operation of the great movements of the earth's crust which have produced mountains, plains, and table-lands, are still involved in some mystery. One patent cause is the unequal settling of the crust toward the center; but it is not so generally understood as it should be that the greater settlement of the ocean-bed has necessitated its pressure against the sides of the continents in the same manner that a huge ice-floe crushes a ship or a pier. The geological map of North America shows this at a glance, and impresses us with the fact that large portions of the earth's crust have not only been folded, but bodily pushed back for great distances. On looking at the extreme north, we see that the great Laurentian mass of central Newfoundland has acted as a protecting pier to the space immediately west of it, and has caused the Gulf of St. Lawrence to re-

main an undisturbed area since palæozoic times. Immediately to the south of this, Nova Scotia and New Brunswick are folded back. Still farther south, as Guyot has shown, the old sediments have been crushed in sharp folds against the Adirondack mass, which has sheltered the table-land of the Catskills and of the Great Lakes. South of this, again, the rocks of Pennsylvania and Maryland have been driven back in a great curve to the west. Nothing, I think, can more forcibly show the enormous pressure to which the edges of the continents have been exposed, and at the same time the great sinking of the ocean-beds. Complex and difficult to calculate though these movements of plication are, they are more intelligible than the apparently regular pulsations of the flat continental areas, whereby they have alternately been below and above the waters, and which must have depended on somewhat regularly recurring causes, connected either with the secular cooling of the earth, or with the gradual retardation of its rotation, or with both. Throughout these changes, each successive elevation exposed the rocks for long ages to the decomposing influence of the atmosphere. Each submergence swept away, and deposited as sediment, the material accumulated by decay. Every change of elevation was accompanied with changes of climate and with modifications of the habitats of animals and plants. Were it possible to restore accurately the physical geography of the earth in all these respects, for each geological period, the data for the solution of many difficult questions would be furnished.

It is an unfortunate circumstance that conclusions in geology, arrived at by the most careful observation and induction, do not remain undisturbed, but require constant vigilance to prevent them from being overthrown. Sometimes, of course, this arises from new discoveries throwing new light on old facts; but when this occurs it rarely works the complete subversion of previously received views. The more usual case is, that some over-zealous specialist suddenly discovers what seems to him to overturn all previous beliefs, and rushes into print with a new and plausible theory, which at once carries with him a host of half-informed people, but the insufficiency of which is speedily made manifest.

Had I written this address a few years ago, I might have referred to the mode of formation of coal as one of the things most surely settled and understood. The labors of many eminent geologists, microscopists, and chemists in the Old and the New Worlds had shown that coal nearly always rests upon old-soil surfaces penetrated with roots, and that coal-beds have in their roofs erect trees, the remains of the last forests that grew upon them. Logan and I have illustrated this in the case of the series of more than sixty successive coal-beds exposed at the South Joggins, and have shown unequivocal evidence of land-surfaces at the time of the deposition of the coal. Microscopical examination has proved that these coals are composed of the materials

of the same trees whose roots are found in the under-clays, and their stems and leaves in the roof-shales; that much of the material of the coal has been subjected to sub-aërial decay at the time of its accumulation; and that in this, ordinary coal differs from bituminous shale, earthy bitumen, and some kinds of cannel, which have been formed under water; that the matter remaining as coal consists almost entirely of epidermal tissues, which, being suberose in character, are highly carbonaceous, very durable, and impermeable by water,* and are hence the best fitted for the production of pure coal; and finally that the vegetation and the climatal and geographical features of the coal period were eminently fitted to produce in the vast swamps of that period precisely the effects observed. All these points and many others have been thoroughly worked out for both European and American coal-fields, and seemed to leave no doubt on the subject. But several years ago certain microscopists observed on slices of coal layers filled with spore-cases—a not unusual circumstance, since these were shed in vast abundance by the trees of the coal-forests, and because they contain suberose matter of the same character with epidermal tissues generally. Immediately we were informed that all coal consists of spores; and, this being at once accepted by the unthinking, the results of the labors of many years are thrown aside in favor of this crude and partial theory. A little later, a German microscopist has thought proper to describe coal as made up of minute algæ, and tries to reconcile this view with the appearances, devising at the same time a new and formidable nomenclature of generic and specific names, which would seem largely to represent mere fragments of tissues. Still later, some local facts in a French coal-field have induced an eminent botanist of that country to revive the drift theory of coal, in opposition to that of growth *in situ*. A year or two ago, when my friend Professor Williamson, of Manchester, informed me that he was preparing a large series of slices of coal with the view of revising the whole subject, I was inclined to say that, after what had been done by Lyell, Goeppert, Logan, Hunt, Newberry, and myself, this was scarcely necessary; but, in view of what I have just stated, it may be that all he can do will be required to rescue from total ruin the results of our labors.

An illustration of a different character is afforded by the controversy now raging with respect to the so-called fucoids of the ancient rocks. At one time the group of fucoids, or algæ, constituted a general place of refuge for all sorts of unintelligible forms and markings; graptolites, worm-trails, crustacean tracks, shrinkage-cracks, and, above all, rill-markings, forming a heterogeneous group of fucoidal remains distinguished by generic and specific names. To these were also added some true land-plants badly preserved, or exhibiting structures not well understood by botanists. Such a group was sure to be eventually

* "Acadian Geology," third edition, supplement, p. 68.

dismembered. The writer has himself done something toward this,* but Professor Nathorst has done still more;† and now some intelligible explanation can be given of many of these forms. Quite recently, however, the Count de Saporta, in an elaborate illustrated memoir,‡ has come to the defense of the fucoids, more especially against the destructive experiments of Nathorst, and would carry back into the vegetable kingdom many things which would seem to be mere trails of animals. While writing this address, I have received from Professor Crié, of Rennes, a paper in which he not only supports the algal nature of rusichnites, arthrichnites, and many other supposed fucoids, but claims for the vegetable kingdom even receptaculites and archæocyathus. It is not to be denied that some of the facts which he cites, respecting the structure of the siphoniæ and of certain modern incrusting algæ, are very suggestive, though I can not agree with his conclusions. My own experience has convinced me that, while non-botanical geologists are prone to mistake all kinds of markings for plants, even good botanists, when not familiar with the chemical and mechanical conditions of fossilization, and with the present phenomena of tidal shores, are quite as easily misled, though they are very prone, on the other hand, to regard land-plants of some complexity, when badly preserved, as mere algæ. In these circumstances it is very difficult to secure any consensus, and the truth is only to be found by careful observation of competent men. One trouble is, that these usually obscure markings have been despised by the greater number of paleontologists, and probably would not now be so much in controversy were it not for the use made of them in illustrating supposed phylogenies of plants.

It would be wrong to close this address without some reference to that which is the veritable *pons asinorum* of the science, the great and much-debated glacial period. I trust that you will not suppose that, in the end of an hour's address, I am about to discuss this vexed question. Time would fail me even to name the hosts of recent authors who have contended in this arena. I can hope only to point out a few landmarks which may aid the geological adventurer in traversing the slippery and treacherous surface of the hypothetical ice-sheet of pleistocene times, and in avoiding the yawning crevasses by which it is traversed.

No conclusions of geology seem more certain than that great changes of climate have occurred in the course of geological time; and the evidence of this in that comparatively modern period which immediately preceded the human age is so striking that it has come to be known as pre-eminently the ice age, while, in the preceding ter-

* "Footprints and Impressions on Carboniferous Rocks," "American Journal of Science," 1873.

† Royal Swedish Academy, Stockholm, 1881.

‡ "À propos des Algues Fossiles," Paris, 1883.

tiary periods, temperate conditions seem to have prevailed even to the pole. Of the many theories as to these changes which have been proposed, two seem at present to divide the suffrages of geologists, either alone, or combined with each other. These are—1. The theory of the precession of the equinoxes in connection with the varying eccentricity of the earth's orbit, advocated more especially by Croll; and, 2. The different distribution of land and water as affecting the reception and radiation of heat and the ocean-currents—a theory ably propounded by Lyell, and subsequently extensively adopted, either alone or with the previous one. One of these views may be called the astronomical; the other, the geographical. I confess that I am inclined to accept the second or Lyellian theory, for such reasons as the following: 1. Great elevations and depressions of land have occurred in and since the pleistocene, while the alleged astronomical changes are not certain, more especially in regard to their probable effect on the earth. 2. When the rival theories are tested by the present phenomena of the southern polar region and the North Atlantic, there seem to be geographical causes adequate to account for all except extreme and unproved glacial conditions. 3. The astronomical cause would suppose regularly recurring glacial periods of which there is no evidence, and it would give to the latest glacial age an antiquity which seems at variance with all other facts. 4. In those more northern regions where glacial phenomena are most pronounced, the theory of floating sheets of ice, with local glaciers descending to the sea, seems to meet all the conditions of the case; and these would be obtained, in the North Atlantic at least, by very moderate changes of level, causing, for example, the equatorial current to flow into the Pacific, instead of running northward as a gulf stream. 5. The geographical theory allows the supposition not merely of vicissitudes of climate quickly following each other in unison with the movements of the surface, but allows also of that near local approximation of regions wholly covered with ice and snow, and others comparatively temperate, which we see at present in the north.

If, however, we are to adopt the geographical theory, we must avoid extreme views; and this leads to the inquiry as to the evidence to be found for any such universal and extreme glaciation as is demanded by some geologists.

The only large continental area in the northern hemisphere supposed to be entirely ice- and snow-clad is Greenland; and this, so far as it goes, is certainly a local case, for the ice and snow of Greenland extend to the south as far as 60° north latitude, while both in Norway and in the interior of North America the climate in that latitude permits the growth of cereals. Further, Grinnell Land, which is separated from North Greenland only by a narrow sound, has a comparatively mild climate, and, as Nares has shown, is covered with verdure in summer. Still further, Nordenskiöld, one of the most experienced

Arctic explorers, holds that it is probable that the interior of Greenland is itself verdant in summer, and is at this moment preparing to attempt to reach this interior oasis. Nor is it difficult, with the aid of the facts cited by Woeickoff and Whitney,* to perceive the cause of the exceptional condition of Greenland. To give ice and snow in large quantities, two conditions are required—first, atmospheric humidity; and, secondly, cold precipitating regions. Both of these conditions meet in Greenland. Its high coast-ranges receive and condense the humidity from the sea on both sides of it and to the south. Hence the vast accumulation of its coast snow-fields, and the intense discharge of the glaciers emptying out of its valleys. When extreme glacialists point to Greenland, and ask us to believe that in the glacial age the whole continent of North America as far south as the latitude of 40° was covered with a continental glacier, in some places several thousands of feet thick, we may well ask, first, what evidence there is that Greenland, or even the Antarctic Continent, at present shows such a condition; and, secondly, whether there exists a possibility that the interior of a great continent could ever receive so large an amount of precipitation as that required. So far as present knowledge exists, it is certain that the meteorologist and the physicist must answer both questions in the negative. In short, perpetual snow and glaciers must be local, and can not be continental, because of the vast amount of evaporation and condensation required. These can only be possible where comparatively warm seas supply moisture to cold and elevated land; and this supply can not, in the nature of things, penetrate far inland. The actual condition of interior Asia and interior America in the higher northern latitudes affords positive proof of this. In a state of partial submergence of our northern continents, we can readily imagine glaciation by the combined action of local glaciers and great ice-floes; but, in whatever way the phenomena of the bowlder clay and of the so-called terminal moraines are to be accounted for, the theory of a continuous continental glacier must be given up.

I can not better indicate the general bearing of facts, as they present themselves to my mind in connection with this subject, than by referring to a paper by Dr. G. M. Dawson on the distribution of drift over the great Canadian plains east of the Rocky Mountains.† I am the more inclined to refer to this, because of its recency, and because I have so often repeated similar conclusions as to Eastern Canada and the region of the Great Lakes.

The great interior plain of Western Canada, between the Laurentian axis on the east and the Rocky Mountains on the west, is seven hundred miles in breadth, and is covered with glacial drift, presenting one of the greatest examples of this deposit in the world. Proceed-

* "Memoir on Glaciers," Geological Society of Berlin, 1881; "Climatic Changes," Boston, 1883.

† "Science," July 1, 1883.

ing eastward from the base of the Rocky Mountains, the surface, at first more than four thousand feet above the sea-level, descends by successive steps to twenty-five hundred feet, and is based on cretaceous and Laramie rocks, covered by bowlder clay and sand, in some places from one hundred to two hundred feet in depth, and filling up pre-existing hollows, though itself sometimes piled into ridges. Near the Rocky Mountains the bottom of the drift consists of gravel not glaciated. This extends to about one hundred miles east of the mountains, and must have been swept by water out of their valleys. The bowlder clay resting on this deposit is largely made up of local *débris* in so far as its paste is concerned. It contains many glaciated bowlders and stones from the Laurentian region to the east, and also smaller pebbles from the Rocky Mountains; so that at the time of its formation there must have been driftage of large stones for seven hundred miles or more from the east, and of smaller stones from a less distance on the west. The former kind of material extends to the base of the mountains, and to a height of more than four thousand feet. One bowlder is mentioned as being forty-two by forty by twenty feet in dimensions. The highest Laurentian bowlders seen were at an elevation of forty-six hundred and sixty feet, on the base of the Rocky Mountains. The bowlder clay, when thick, can be seen to be rudely stratified, and at one place includes beds of laminated clay with compressed peat, similar to the forest-beds described by Worthen and Andrews in Illinois, and the so-called interglacial beds described by Hinde on Lake Ontario. The leaf-beds on the Ottawa River and the drift-trunks found in the bowlder clay of Manitoba belong to the same category, and indicate that throughout the glacial period there were many forest oases far to the north. In the valleys of the Rocky Mountains opening on these plains there are evidences of large local glaciers now extinct, and similar evidences exist on the Laurentian highlands on the east.

Perhaps the most remarkable feature of the region is that immense series of ridges of drift piled against an escarpment of Laramie and cretaceous rocks, at an elevation of about twenty-five hundred feet, and known as the "Missouri Coteau." It is in some places thirty miles broad and a hundred and eighty feet in height above the plain at its foot, and extends north and south for a great distance; being, in fact, the northern extension of those great ridges of drift which have been traced south of the Great Lakes, and through Pennsylvania and New Jersey, and which figure on the geological maps as the edge of the continental glacier—an explanation obviously inapplicable in those Western regions where they attain their greatest development. It is plain that in the North it marks the western limit of the deep water of a glacial sea, which at some periods extended much farther west, perhaps with a greater proportionate depression in going westward, and on which heavy ice from the Laurentian districts on the

east was wafted southwestward by the Arctic currents, while lighter ice from the Rocky Mountains was being borne eastward from these mountains by the prevailing westerly winds. We thus have in the West, on a very wide scale, the same phenomena of varying submergence, cold currents, great ice-floes, and local glaciers producing icebergs, to which I have attributed the bowlder clay and upper bowlder drift of Eastern Canada.

A few subsidiary points I may be pardoned for mentioning here. The rival theories of the glacial period are often characterized as those of land glaciation and sea-borne icebergs. But it must be remembered that those who reject the idea of a continental glacier hold to the existence of local glaciers on the highlands more or less extensive during different portions of the great pleistocene submergence. They also believe in the extension of these glaciers seaward and partly water-borne, in the manner so well explained by Mattieu Williams; in the existence of those vast floes and fields of current-and tide-borne ice whose powers of transport and erosion we now know to be so great; and in a great submergence and re-elevation of the land, bringing all parts of it and all elevations up to five thousand feet successively under the influence of these various agencies, along with those of the ocean-currents. They also hold that, at the beginning of the glacial submergence, the land was deeply covered by decomposed rock, similar to that which still exists on the hills of the Southern States, and which, as Dr. Hunt has shown, would afford not only earthy *débris*, but large quantities of bowlders ready for transportation by ice.

I would also remark that there has been the greatest possible exaggeration as to the erosive action of land-ice. In 1865, after a visit to the Alpine glaciers, I maintained that in these mountains glaciers are relatively protective rather than erosive agencies, and that the *détritus* which the glacier streams deliver is derived mostly from the atmospherically wasted peaks and cliffs that project above them. Since that time many other observers have maintained like views, and very recently Mr. Davis, of Cambridge, and Mr. A. Irving have ably treated this subject.* Smoothing and striation of rocks are undoubtedly important effects, both of land-glaciers and heavy sea-borne ice; but the leveling and filling agency of these is much greater than the erosive. As a matter of fact, as Newberry, Hunt, Belt, Spencer, and others have shown, the glacial age has dammed up vast numbers of old channels which it has been left for modern streams partially to excavate.

The till, or bowlder clay, has been called a "ground moraine," but there are really no Alpine moraines at all corresponding to it. On the other hand, it is more or less stratified, often rests on soft materi-

* "Proceedings of the Boston Society of Natural History," xxii; "Journal of the Geological Society of London," February, 1883.

als which glaciers would have swept away, sometimes contains marine shells, or passes into marine clays in its horizontal extension, and invariably in its imbedded bowlders and its paste shows an unoxidized condition, which could not have existed if it had been a sub-aërial deposit. When the Canadian till is excavated, and exposed to the air, it assumes a brown color, owing to oxidation of its iron; and many of its stones and bowlders break up and disintegrate under the action of air and frost. These are unequivocal signs of a sub-aqueous deposit. Here and there we find associated with it, and especially near the bottom and at the top, indications of powerful water-action, as if of land-torrents acting at particular elevations of the land, or heavy surf and ice action on coasts; and the attempts to explain these by glacial streams have been far from successful. A singular objection sometimes raised against the sub-aqueous origin of the till is its general want of marine remains, but this is by no means universal; and it is well known that coarse conglomerates of all ages are generally destitute of fossils, except in their pebbles; and it is further to be observed that the conditions of an ice-laden sea are not those most favorable for the extension of marine life, and that the period of time covered by the glacial age must have been short, compared with that represented by some of the older formations.

This last consideration suggests a question which might afford scope for another address of an hour's duration—the question how long time has elapsed since the close of the glacial period. Recently the opinion has been gaining ground that the close of the ice age is very recent. Such reasons as the following lead to this conclusion: The amount of atmospheric decay of rocks and of denudation in general, which have occurred since the close of the glacial period, are scarcely appreciable; little erosion of river-valleys or of coast-terraces has occurred. The calculated recession of water-falls and of production of lake-ridges lead to the same conclusion. So do the recent state of bones and shells in the pleistocene deposits and the perfectly modern facies of their fossils. On such evidence the cessation of the glacial cold and settlement of our continents at their present levels are events which may have occurred not more than six thousand or seven thousand years ago, though such time estimates are proverbially uncertain in geology. This subject also carries with it the greatest of all geological problems, next to that of the origin of life; namely, the origin and early history of man. Such questions can not be discussed in the closing sentences of an hour's address. I shall only draw from them one practical inference. Since the comparatively short post-glacial and recent periods apparently include the whole of human history, we are but new-comers on the earth, and therefore have had little opportunity to solve the great problems which it presents to us. But this is not all. Geology as a science scarcely dates from a century ago. We have reason for surprise, in these circumstances, that it has

learned so much, but for equal surprise that so many persons appear to think it a complete and full-grown science, and that it is entitled to speak with confidence on all the great mysteries of the earth that have been hidden from the generations before us. Such being the newness of man and of his science of the earth, it is not too much to say that humility, hard work in collecting facts, and abstinence from hasty generalization, should characterize geologists, at least for a few generations to come.

In conclusion, science is light, and light is good; but it must be carried high, else it will fail to enlighten the world. Let us strive to raise it high enough to shine over every obstruction which casts any shadow on the true interests of humanity. Above all, let us hold up the light, and not stand in it ourselves.

INLETS FOR INFECTION.*

By R. THORNE THORNE, F. R. C. P.

IN selecting a subject to bring before you, I felt that I should not be trespassing beyond the lines indicated by the committee who have organized this series of lectures if I addressed my remarks to some points connected with those specific fevers the prevention of which must be regarded as coming within the scope of sanitary administration. I may, perhaps, indicate the importance of such a subject by quoting a few figures from the reports of the Registrar-General of England. Limiting myself to those diseases the spread of which is admittedly to be controlled by the adoption either of efficient sanitary works, or of such sanitary measures as isolation and disinfection, I find that during 1871–'80 the following deaths were registered in England and Wales: From typhus fever, 13,975; from enteric or typhoid fever, 78,421; from simple continued fever, which when fatal is probably nothing less than an ill-defined form of enteric fever, 25,643; from diphtheria, 29,425; and from scarlet fever, otherwise called scarlatina, 174,232. These deaths are essentially due to diseases which may be called preventable, and they amount in all to 321,696 in the ten years. But the influence of these diseases upon the population can not be judged of by the death-roll alone. For every fatal case there have probably occurred at least ten non-fatal attacks, and thus we come to be confronted with a total of 3,538,656 attacks from the preventable specific fevers. Mr. Simon, C. B., F. R. S., in dealing with such death returns, has said: "Of the incalculable amount of physical suffering and disablement which they occasion, and of the sorrows and

* Abridged from a lecture delivered at Cheltenham, March 15, 1883, and published in "The Practitioner."

anxieties, the often permanent darkening of life, the straitened means of subsistence, the very frequent destitution and pauperism, which attend or follow such suffering, death statistics, to which alone I can refer, testify only in sample or by suggestion."

The means by which infection is likely to be conveyed to households are far too numerous to be dealt with in a single lecture, and I have thought it best to select for consideration three or four of what I feel to be among the more important, and to deal with these in detail.

In a report on an epidemic of enteric fever at Croydon, in 1875, Dr. Buchanan, F. R. S., makes use of the following words: "The air of the sewers is, as it were, 'laid on' to houses." That significant expression "laid on" comes in aptly, as giving prominence to the special features of one of the channels for conveying infection to households, to which I propose drawing your attention. From the inside of every ordinary dwelling-house there pass certain waste-pipes intended to convey liquid refuse, first to the house-drains without, and thence to the public sewers. It is the custom to regard these conduits as passing from house to sewer, but this evening I would ask you to compare them with the pipes for the supply of coal-gas, and to view them rather as passing from the sewer as a center to the periphery within our dwelling-houses. In our comparison the public sewer may be regarded as corresponding with the gasometer; the house-drain and the waste-pipes as representing the service-pipes for gas; and the so-called "trap" indoors as taking the place of the metal tap found in connection with each gas-bracket. Sewer-air, even in its normal state, is a grave source of danger to health; but when the sewers receive in their course along the streets the infectious refuse discharged from houses where specific disease prevails, then the sewer-air — harmful hitherto—is changed into an intense poison.

How is it usually sought to debar this poisonous agent from dwellings? The sole means adopted, in nine cases out of ten, consists in placing at some point of the pipe which connects the interior of the house with the interior of the sewer a small body of water which is known as a "trap," and which is designed to act as a barrier to the passage of all sewer-air. The contrivance most commonly resorted to is the so-called bell-trap, an apparatus in which the rim of a bell-shaped cup is suspended in a small body of water contained within a circular depression. This form of trap is of all the least efficient; it is not only one in which the water-lock constituting the trapping may at any moment be entirely removed at the will of the individual, but at its best it provides between the house and the sewer a layer of water only about one half or three quarters of an inch in depth. Even the most efficient of all traps, the so-called "siphon-bend," is not much better. Dr. Andrew Fergus maintains that trapping has but little effect in keeping sewer-air out of houses, as the entrance of the con-

taminating air is not so much due to occasional and temporary failure in the efficacy of the trap as to an almost constant absorption of sewer-air by the water on the sewer-side of the trap, and its subsequent discharge from the house-side. Dr. Fergus has made a series of experiments in a glass tube so bent as to resemble the ordinary "siphon" trap, and charged with water. Certain gases were evolved on what we may call the sewer-side of the trap (*b*), and tests were applied to ascertain whether the gases succeeded in passing through the water. The results as tabulated by Dr. Fergus are as follows:

GAS.	Sp. gr.	Source.	Test.	Time for reaction to show.
Ammonia.....	·50	Solution.	Litmus.	15 minutes.
"	·50	"	Nessler.	30 minutes. Ate through a small wire in less than 24 hours.
Sulphurous acid	2·25	"	Litmus.	1 hour.
Sulphuretted hydrogen	1·25	"	Lead paper.	3 to 4 hours.
Chlorine.....	2·50	"	Iodide of starch paper.	4 hours.
"	2·50	"	Litmus-water in trap.	Began to show in a few minutes. In half an hour the whole was bleached.
Carbonic acid.....	1·50	Generated	Lime-water in trap.	1½ hour.
"	1·50	"	Litmus suspended over water in trap.	3 hours.

It was, however, urged that the results would probably be different if the trap were ventilated. A ventilating-shaft (*c*) was, therefore, inserted in the upper part of the bend on the sewer-side, and the experiments were repeated. "The results," says Dr. Fergus, "were much the same, except that the reaction was a little longer in showing itself."

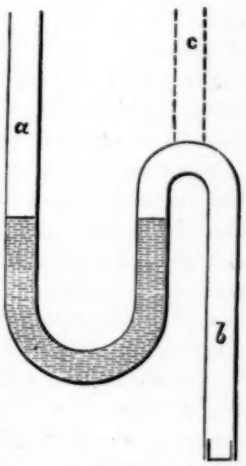

FIG. 1.

Ordinary sewer-air may be taken to contain in every hundred parts about seventy-nine parts of nitrogen, nearly twenty of oxygen, not quite half a part of carbonic acid, and traces of sulphuretted hydrogen, marsh-gas, and ammonia. These gases, however, when inhaled in the proportions indicated, can hardly be regarded as materially affecting health. Sewer-air also contains organic matter in the form of vapor, and of definite particles; but doubts have been expressed as to whether these organic particles succeed in making their way through water-traps, and some carefully executed experiments of Dr. Neil Carmichael, of Glasgow, have gone far to show that they do not do so.

There are other ways, however, in which danger comes about. The water in traps is apt to be sucked out by siphon-action, as the

result, for example, of a rapid flow along the drain into which the waste-pipes discharge, and, under these circumstances, sewer-air and its organic ingredients pass unhindered into our houses. So, also, traps are liable to be forced by the pressure of the sewer-air upon them. Having regard to some of Dr. Carmichael's experiments, it might at first sight be supposed that organic particles contained in bubbles of air would be detained in their passage through a water-trap. This, however, is by no means the case. In certain experiments carried out at the Royal Institution by Professor Tyndall, F. R. S., it was found that air, passing through an experimental tube, carried with it "a considerable amount of mechanically suspended matter." Dr. Carmichael freely admits the inadequacy of water-traps as they exist, and points out many dangers attendant upon them. He enforces the caution he gives by a case related in a report of Dr. J. B. Russell, Medical Officer of Health for Glasgow. In certain tenements of one apartment, having no connection with the sewer, there had been a death-rate from diphtheria of 12, and from enteric fever of 24·9, per hundred thousand inhabitants. The introduction of a sink increased the diphtheria death-rate to 25·3—i. e., 110 per cent—and from enteric fever to 67·7—i. e., 171 per cent—the rate of mortality from certain allied diseases also undergoing a corresponding increase. Not knowing whether there were other circumstances that favored this special incidence of disease upon these tenements, I should find some difficulty in asserting that the drain-connection was the cause of the whole of the increase in the diseases specified; nevertheless, Dr. Russell's opinion that it was, carries great weight.

One striking instance, which further illustrates this point, came under my own cognizance. Some years ago I received instructions to inquire into the cause of an outbreak of enteric fever in a small township in Yorkshire. The main incidence of the disease was upon a group of houses, which formed an irregular square, containing twenty-three cottages, occupied by eighty-eight persons. Up to the first week in June the inhabitants of this locality had been free from fever, but at that date a series of attacks of well-marked enteric fever occurred almost simultaneously in a number of houses, fresh attacks taking place day by day until, in the space of a few weeks, one or more inmates in fifteen out of the twenty-three cottages had been attacked, the number of patients amounting to thirty-five. Now, when the contagium of enteric fever is conveyed by water, the persons attacked are generally attacked almost simultaneously. There is, however, in the case of enteric fever, a definite interval, generally of some ten to fourteen days, between the reception of the poison into the system and the occurrence of symptoms of the disease. The water-supply which these families generally used in common was a well in the neighboring field; but this had been disused for a period which more than covered the "period of incubation" above referred to.

In the course of my investigations I entered a wash-house belonging to one group of the houses in question. I was followed in by its owner, an old lady, who sought at once to satisfy my curiosity by assuring me that the building was rarely used; indeed, that the last time it was used was six weeks ago, at which date she had washed some linen there for a young man who had been very ill, and who lived some distance away. I had before this noticed that all the cottages were provided with sinks in their living-rooms, and that by means of these sink-pipes, which were in unbroken communication with a drain outside, offensive effluvia at times made their way into the dwellings, these having been especially noticed toward evening, when the houses were shut up and the fires were lighted. It at once occurred to me that if the sick man referred to had suffered from enteric fever, and if the drains for the several parts of the square all communicated

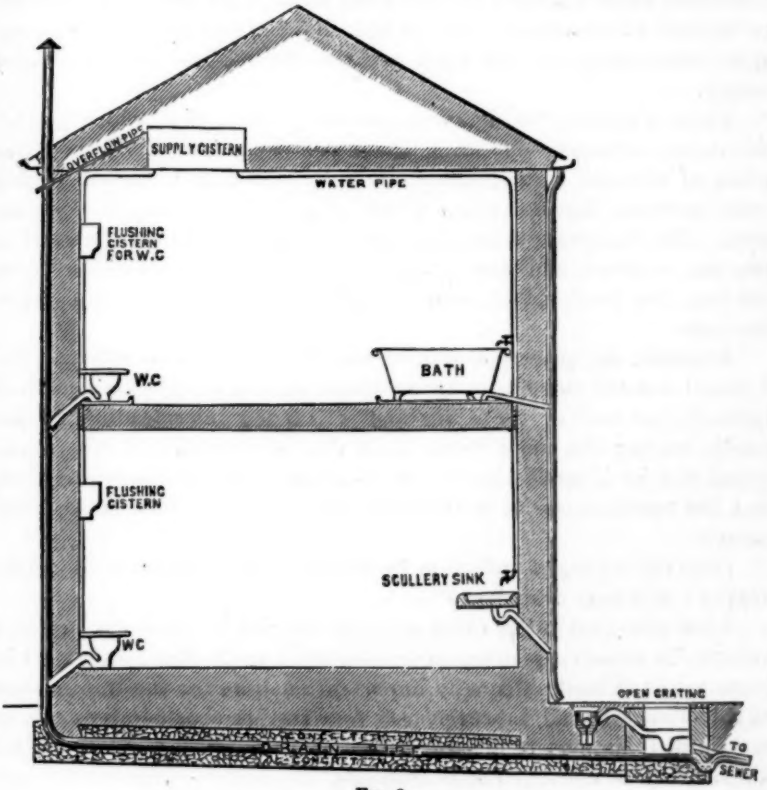

FIG. 2.

with the sewer by which the liquid refuse from the wash-house was conveyed away, then a specifically contaminated sewer-air had replaced the ordinary foul effluvia, and that in this way infection had been "laid on" to the several households. I found that the young man

had indeed suffered from enteric fever, and, laborers having laid bare the drains, these were all seen to communicate with the sewer above mentioned, this being further of such faulty construction as to be little better than an elongated cesspool.

In view of the danger of direct communication between a sewer and our dwellings, "What," you may fairly ask, "is the remedy?" I answer that the remedy is simply breaking the direct connection which has been referred to. In the case of a waste-pipe from a sink, the pipe should be brought through the wall into the outer air, and there be cut off, its contents flowing to a trapped drain-inlet outside the dwelling. (This point was explained by means of diagrams.) This principle of disconnection is, however, of much wider application than I have as yet indicated. All waste-pipes coming from lavatories, baths, water-closets, etc., as also the overflow-pipes from cisterns, and the rain-pipes, especially such as have their heads anywhere near windows, or beneath overhanging eaves, should, like the sink-pipes, have an air-space intervening between them and the drain-inlets into which they empty.

There is exceptional danger in the direct connection which is often maintained between houses and the sewers by means of the overflow-pipes of cisterns. These pipes are very generally provided with a "siphon-bend," but the water constituting the trapping is often absent. The ball-cock of the cistern is intentionally so contrived as to prevent overflow, and hence, when once evaporation of the water in the trap has taken place, sewer-air passes through it without let or hindrance.

Adapting the principle of disconnection to the house-drain itself, I would further urge that an air-break should always be contrived between the end of the drain and a trapped inlet leading to the public sewer; the more so as when this is effected a further safeguard can be insured, namely, two ventilating apertures to the drain, and the maintenance of a constant current of air through its entire length.

(The conveying of infection by means of an "intermittent water-supply" was next described.)

I feel sure that many other methods by which water can act as a vehicle for conveying infection will occur to you. Milk, also, must be regarded as at least an equally important medium for the transmission of infection. I shall, however, ask your further consideration only of certain distributions of ice and cream as forming channels by which disease may be conveyed to households.

I believe that the first instance in which the consumption of ice was shown to have been followed by an outbreak of disease is that recorded in the "Seventh Annual Report of the State Board of Health of Massachusetts." The occurrence took place in one of the large hotels at Rye Beach, New Hampshire. At the beginning of the season

of 1875 about a thousand visitors were assembled at Rye Beach, and a considerable number were attacked with a series of symptoms which led to the suspicion that they had consumed some noxious article. The incidence of the disease was entirely confined to three hundred persons occupying one of the large hotels. The sanitary state of this hotel is said to have been exceptionally good, and, although suspicion seemed at first to attach to the water-supply, yet the disease was found to have affected many who, "having apprehended trouble from the use of the water," which was strongly impregnated with salts of lime and magnesia, "had carefully limited themselves since their arrival to other beverages." Indeed, as the result of a careful process of elimination, suspicion came at last to be directed to the ice furnished to the house. The water obtained by melting the ice was discolored and charged with suspended matter, and gave off a decidedly disagreeable odor; the atmosphere of the ice-house was offensive, and some persons who had used the ice away from the hotel were found to have suffered in the same way from violent illness. The ice in question had been derived from a local pond, the water of which was found to have become foul from long-continued stagnation; one portion of the pond, measuring about five hundred feet in length and one hundred and fifty feet in width, was occupied by "a homogeneous mass of putrescent matter." A piece of ice, carefully cleansed from all surface impurities, was then melted, and the water thus obtained was submitted to chemical analysis, the result being the detection in it of a quantity of "decaying organic matter." The use of the ice had also in the mean time been discontinued, and coincident with its disuse "there was observed an abrupt amelioration in the symptoms of nearly all who had hitherto been ill." So, also, no fresh attacks occurred during the remainder of the season.

Even among the more educated classes there prevails an impression that even if water is contaminated it is purified by freezing. Many experiments have, however, shown the fallacy of this view. In some of these made recently by Mr. C. P. Pengra, an American chemist, various organic matters (urea, albumen, etc.) were mixed with water, and the specimens were gradually frozen. A certain amount of purification did take place—the ice containing thirty and even forty per cent less organic matter than the unfrozen liquid. But a large amount of the added pollution remained, and the investigator, though expressing surprise that the purification had been as great as it was, says that the experiments afford abundant proof that we ought not to tolerate the indiscriminate collection of ice.

These experiments do not, however, prove that the contagium of an infectious fever can withstand the process of freezing, but as to this we are not left in doubt. Dr. E. Klein, F. R. S., thus reports the results of some of his experiments in freezing *bacillus anthracis:* "I have exposed in a capillary pipette fluid full of spores to the influence

of ether spray, and, having thus kept the liquid frozen for several minutes, have injected it into the Guinea-pig and rabbit with fatal result. . . . I then placed a capillary tube filled with spores in a mixture of ice and salt, and kept it there for one hour exposed to a temperature of 12° to 15° Cent. below freezing-point; after thawing, the material was injected into the subcutaneous tissue of a Guinea-pig. This animal died of typical anthrax on the third day."

We are thus bound to accept the position that the morbific organisms, the introduction of which into the human system produces specific infectious diseases, are not destroyed by freezing, but, on the contrary, that ice collected from an infected water and supplied to households would act as a vehicle for the introduction of the poison of those diseases. In short, a wholesome ice can be derived only from a wholesome water.

I now pass to my last point. On the 9th of June, 1875, a party of sixteen persons sat down to dinner at a house in South Kensington, and later on in the evening about one hundred and fifty additional guests assembled with the family of the host and hostess in the drawing-room; the service of the house was also re-enforced for the evening by seven extra servants. Within five days eighteen of the assembled guests suffered from more or less well-marked attacks of scarlet fever; two others had "sore throats"; one of the waiters had scarlet fever; and a few days later a lady, not at the house on the 9th, but who lunched there the next day, was found to be suffering from a distinct attack of the disease. In all, twenty-two persons were attacked.

The circumstances of the outbreak were investigated by Dr. Buchanan, F. R. S., and his report on it is specially instructive as indicating the method in which such an inquiry should be conducted. It was ascertained that the scarlet fever could not have been communicated by any of the guests, by any member of the host's family, nor by any of the servants, nor indeed did the circumstances of the outbreak suggest infection from such a source. On the other hand, strong circumstantial evidence was forthcoming in favor of the infection having been communicated by means of some article of food or drink.

The dinner guests were the principal ones affected; several of the household who could not have touched any of the articles of food served up escaped altogether, and there was a marked incidence of the disease on those who had several opportunities of eating certain exceptional articles supplied on that day. Up to this point, however, no one article of food had come under suspicion.

Two special supplies of cream were delivered at the house on the day of the entertainment; one, which arrived at 4 P. M., was "double cream" from a London dairy, and was used for ice-puddings, custards, and "creams"; the other, arriving at 5 P. M., was from a Hampshire dairy, and was mainly used as cream. The latter supply was generally

used by all the evening guests, among whom there was but little scarlet fever; the former, or four-o'clock, cream was distributed essentially to the family and to the dinner guests. It was again used at luncheon the next day, and thirteen persons who were known to have had opportunity of partaking of it suffered from scarlet fever within five days. The bulk of this four-o'clock cream was used in the preparation of articles which had to be boiled previous to their being used in a cool or frozen form, and those persons who partook of such articles alone were not specially attacked. But of this cream some that was in excess of the cook's requirements was put into at least one jug along with the five-o'clock cream.

This mingling of the two creams added materially to the difficulty of the investigation, because it was that remnant of the four-o'clock cream which had not been boiled previous to use to which interest was now found specially to attach. For "no less than seven ladies who were at the dinner, and who took cream in their coffee in the drawing-room, afterward became ill, none of them who took that cream having escaped." There was, however, no such incidence of disease on the gentlemen who took coffee down-stairs. And further, whereas all who partook of cream on the day following the dinner were ill, none of those who did not partake of it suffered. Now, it was known that it was the four-o'clock cream that was used at the luncheon on the 10th, and if it so happened that the cream which was sent up into the drawing-room with coffee for the ladies who had left the dinner-table was the jug of mingled cream, then that four-o'clock supply from the London dairy comes strongly under suspicion.

The complicated nature of the conditions which had to be contended with in pursuing such an investigation in the metropolis forbade any conclusive demonstration as to the exact method by which this special cream-supply may have become infected. It was, however, ascertained that upon one section of the London dairyman's customers there had been a large incidence of scarlet fever, and a suspicious history as to scarlet fever in the person of one of the dairy-staff who was engaged in milking and carrying out the milk was also elicited. In short, there is little doubt that the cream supplied from this dairy was the vehicle by which the infection of scarlet fever was conveyed to that household in South Kensington.

Some years ago I conducted a somewhat similar inquiry. The same disease had attacked a large proportion of persons who had met at a London dinner-table, and the source of infection must have been some article of food. In this case, fruit as well as cream came under suspicion, and the employment as strawberry-gatherers of persons in the desquamative stage of scarlet fever seemed as likely a source of infection as that which might have operated through the agency of a dairy. The circumstances were, however, too complex to be unraveled, and further inquiry was abandoned.

In considering each of the previous channels of infection I have pointed to some remedy. That which promises most in dealing with infection conveyed in the manner just indicated is the early isolation of persons suffering from the several infectious fevers.

REMARKS ON THE INFLUENCE OF SCIENCE.*

By LESLIE STEPHEN.

"IF it were a qualification for his office," Mr. Stephen remarked, "to be impartial in the sense of not having an opinion on the matter, it would have been hardly possible to select a less qualified chairman in all London than himself. He believed that the spread of scientific influence had not only not been bad, but that the thing of which we stand most in need is a great deal more scientific thought and method in every direction. He felt, however, that his case was so strong that he could afford to give points to the opposite side; and for this reason, and because to a certain extent he was prepared to go with the opener in his remarks, he hoped to be able to point out fairly where the various arguments which had been used found their proper place. The only definition, or rather description, of science which ever appeared satisfactory to him was, that Science is that body of truths which may be held to be definitely established, so that no reasonable person doubts them. To speak of mischievous science is, therefore, to assert that truth is mischievous, an assertion to which no one would be likely to seriously agree, especially in such a place as University College. If it is to be supposed that science is mischievous, it must either be meant that certain false theories which call themselves science are wrongful, which may well be the case, or that the scientific progress at the present time happens to be exercising a mischievous influence.

"No one denies that science may accidentally lead to a large number of our particular mischiefs, as in the case of the invention of dynamite; but it can not in any way be admitted on that account that science is mischievous. For the question arises, If science is bad, what can be substituted for it? and in what way will these mischiefs be remedied if we are not scientific? It is impossible to say that erroneous impressions will make us better off than correct ones. For instance, the old belief in medicine subjected people to years of tor-

* Remarks by Mr. Leslie Stephen in summing up a debate at University College, London, on the motion by Mr. B. Paul Newman: "That the spread of scientific thought and method has, on the whole, exercised an injurious influence on English society." The motion was supported by Mr. N. Mickleman, and opposed by the Rev. A. Capes Tarbolton and Mr. J. G. Pease.

ture because of supposed witchcraft. In India it is still believed in some parts that small-pox is a demon, and efforts are made to propitiate it, so that, if unnecessary torture and small-pox are evils, we are better for the light which the scientific man has thrown on these subjects. Still, it must be admitted that in particular ways the development of science has produced new evils as well as new benefits, and for that matter no sort of progress is made without collateral evils. But the question then remained as to the remedy, and in his opinion that remedy could be very shortly described as more science and not less. There is no sort of conflict between a scientific and a literary education. Everybody ought to have some literary knowledge, and everybody ought to be taught the first principles of science; even a smattering of chemistry might be useful in a literary pursuit. He himself had found what little smattering of science he had acquired at Cambridge and elsewhere of the greatest use in every other kind of study. The habits of thought and feeling acquired by the study even of mathematics, which he took to be the most uninteresting science there is to most individuals, are very useful when one comes to need accurate thinking anywhere, even in matters purely literary.

"It had been urged that science prevents a man from taking the same sort of pleasure in nature as he would do without it. Wordsworth was very fond of saying this, and of denouncing generally the scientific position. But the reason of that was, that Wordsworth knew nothing about science. The result was, that there is no other instance of so great a poet leaving off writing great poems so early in his career. All his finest poems were written in his early life; and the reason is, that he went mooning about the mountains by himself, and did not get any new thoughts. In contrast to him Goethe stands out as a man great in both science and poetry, and is a typical example of the way in which they react on one another. Whenever it was suggested that science is opposed to a love of nature, the speaker always thought of the greatest man of science of modern times, Mr. Darwin, whose books are, apart from their scientific value, quite delightful in their literary style. No one, for instance, could read his 'Voyage in the Beagle' without seeing that Darwin's love of science was only a part of his love of nature. There is, indeed, no conflict between the two, and a man can not strengthen the one side of his nature without at the same time contributing to strengthen the other. Indeed, the reason why so many of our living poets are inferior to those who wrote at the beginning of this century, or to those of an earlier generation still, is just that they have not had the pluck to look science in the face, but have only taken a passing and sideway glance at it.

"An important point in the argument—namely, the relation of science to morality—was suggested by the remarks that had been made on the subject of vivisection. The vivisection question, in the first

place, did not seem to him to be quite fairly stated. People speak as though vivisection were a recent practice, just introduced by a hard-hearted scientific generation. But, in point of fact, vivisection had been going on for many centuries. The thing which was new was the objection to it. The stock argument in favor of vivisection—that by it the discovery of the circulation of the blood was made—is only one of many instances.

"It had been remarked by a previous speaker, with whom he was inclined to agree, that there had been a great increase in humanity in modern times, and that this increase is to be attributed to the growth of science. It is not true, for instance, to say that the abolition of excessive and cruel punishments has been due to the action of a few energetic but unscientific individuals. They were, on the contrary, put down by the growth of the scientific spirit of the age—a spirit closely allied to humanity, and which showed itself in the philosophy of the eighteenth century, especially in the writings of Hume and Bentham. They gave up the idea of punishment as simply a revenge to gratify the feelings of the punishers, and took the utilitarian ground that it must only be administered in so far as it is beneficial to society. They were thus inevitably drawn into denouncing excessive punishments. Romilly, who had been cited by the other side, was probably a pupil of that school; and certainly Bentham and Mill were, who really spread the principles which led to the abolition of excessive punishment. And those principles were only the principles of science applied to morality.

"Though he admired our ancestors of the sixteenth century, he felt bound to admit that they were a brutal lot. An instance of how far we have improved in point of humanity is to be seen in 'Roderick Random.' After having reduced his young, amiable, and beloved hero to very great straits through 'dissipation,' Smollett makes him go to India to purchase a lot of slaves, whom he sells in America at a large profit. This we should consider brutal and degrading conduct, and the fact that we do so consider it marks the great improvement which has taken place in our morality. It is quite true that it is not merely the growth of science, but the general intellectual development of the country, which has put a stop to cruelty; but it is equally true that the growth of science is an integral part of that development, and one that can not be separated from it. None of these things would have been possible unless the intellect had widened; and science has helped to do this. We may hope for similar good results from the application of science to other things; for example, to politics, where there is little enough of scientific principles at present.

"On the religious question I can only say this," Mr. Stephen remarked in conclusion, "that you have got this plain dilemma to face, which can not be avoided. In the first place, if any religion, or religious belief, is true, what can the holders of it have to fear from the

growth of truth, which you call scientific truth? If these beliefs are destroyed, is it not a conclusive proof that they may be false, or at least contain an element of untruth? The religion may, indeed, have been very useful, although not true, and not qualified to satisfy all the aspirations of a cultivated mind. You may see, when a civilized race comes in contact with a lower race, that the effect of the sudden contact may be to destroy the religion and the rule of life of the inferior race, without putting anything in its place. Evils of that kind have been caused by modern science. It is destroying inevitably many beliefs which people have lived under well and happily. It is undeniable that this causes pain, and that it may be injurious to their morality I shall not attempt to deny. But when I am asked to say that therefore science is injurious, I have to come back to my original proposition—the remedy is more science. The only way out of the difficulty is this: we are here, and we have got to go—forward. And the only way is, to apply the test of truth to all our beliefs. This effects a certain amount of pain, as every other kind of progress does; but the only other way is to go on believing what you know to be lies. And, without saying which are true and which are false, I can not see who any person can wish to do anything else but increase the amount of truth, the only satisfactory cure."—*Knowledge.*

A HOME-MADE TELESCOPE.

By Dr. GEORGE PYBURN.

TO render easier of attainment instruments which assist in the investigation or contemplation of natural phenomena, and which supplement man's sense-organs, is to forward by so much the diffusion of real knowledge, and to aid the work of human enlightenment and progress. Indeed, it is not to be doubted that the popularizing of instrumental aids for experimentally verifying the teachings of scientific discoverers will form a notable part of the work of the future schoolmaster.

A few years ago I derived great pleasure from successfully constructing a home-made microscope, guided by directions contained in "The Popular Science Monthly," at a time when my means did not enable me to purchase a good instrument from the optician. I now lay before my fellow-readers the following directions which, step by step, I myself have put in practice, in making a really serviceable achromatic telescope, which will exhibit the moon's surface magnificently, and show very satisfactorily the spots on the sun's disk, the satellites of Jupiter, and other celestial phenomena.

Some people conclude that, if they can not possess a first-class in-

strument of this or that kind, they are better off without any; but a moment's consideration will show the fallacy of this conclusion, and that, on the contrary, even a very poor instrument of observation or precision, or generally of research, in aid of the senses—be it telescope, microscope, spectroscope, balance, thermometer, chronometer, or chemical reagent—is vastly better than none. We have but to remember the great strides made in the acquisition of knowledge by the aid of the very imperfect first-forms of every instrument which has been invented, to be assured of this. Moreover, reflect!—so far as vision is concerned, men, on an average, without instrumental assistance, are inexorably kept at a distance from "things" of ten inches, and must view them under the angle thence subtended. But the use of a simple lens of two and a half inches focus annihilates three fourths of this distance, quadruples the angle of vision, and enables us to see objects only one sixteenth as large as the least we can see with the naked eye. And for some purposes a poor instrument is as good as the best: an egg or a potato gives the housewife all the advantages, in measuring the density of her brine, which she would derive from the most skillfully-constructed hydrometer, or the most accurate balance and specific-gravity bottle. Galileo, with his simple-lens telescope, saw what, perhaps, never man before saw—viz., the moons of Jupiter; and by exhibiting the partial illumination of Venus, with the same imperfect instrument, he removed one of the strongest objections raised against the heliocentric theory of Copernicus. A word to the wise is enough. To my fellow-students I say: Whatever may be your several lines of study, get real knowledge, where possible, by seeing and handling things for yourselves; and, if you can not possess or have the use of a good instrument, do not therefore refuse the assistance of a poor one; but in all cases get and use the best you can. Rembrandt made pictures with a burned stick before ever he possessed pigment or pencil.

The lenses requisite for such a telescope as I have constructed, and shall describe, can be purchased of an optician by those who live in large cities; those who reside at a distance may have them sent by mail at a trifling additional cost. They are: 1. An achromatic object-glass, one and a half inch diameter, with a focus of thirty inches. 2. Two plano-convex lenses of the respective foci of two inches and three fourths of an inch. The object-glass will cost about two dollars, and the other two lenses about seventy-five cents each.

Now procure a *straight* cylindrical roller of pine, two and five eighths inches in diameter, and thirty inches long; procure also a roller seven eighths of an inch in diameter, and fifteen or sixteen inches long. These are for forming the tubes on. Take stout brown wrapping-paper, and, with book-binder's paste, form a tube, twenty-nine inches long, on the large roller. Spread the paste on evenly, and rub the several layers of paper down smoothly with a cloth. Nine or

ten thicknesses of paper will form a tube sufficiently thick and firm for our purpose; but only three or four layers should be laid at one time, and, when these are dry, three or four more may be added, and so on, until the requisite thickness is attained. When thoroughly dry, which will be in three or four days, you will have a stiff, straight, and light tube, the ends of which must be neatly and *squarely* cut off with a sharp knife, so as to leave it, when finished, exactly twenty-eight inches long. With a bit of sponge tied on the end of a stick, and some common or India ink, black the whole inside of the tube, and set it aside, on end, until the other parts are ready.

Next form a tube on the smaller roller, with only four or five thicknesses of paper, fifteen inches in length. *When this is dry*, proceed to form a third tube, over this second one as a roller, using six or seven thicknesses of paper in its formation. This last is to be used as a draw-tube for focusing with, and must be cut neatly and squarely off at the ends to a length of fifteen inches. A portion of the inner tube on which this was formed will be required for the eye-piece, directions for making which I shall give further on. Blacken the insides of both tubes, and set them aside, on end.

One more tube is required, viz., that in which the draw-tube shall slide. It needs to be only six inches long, but, in order to smooth working, should be lined inside with fine cloth or cotton-velvet. Procure, therefore, a piece of black broadcloth, six inches long, and of sufficient width to fit easily and accurately around the draw-tube. Then, using the latter as a roller, first neatly fit the cloth thereon as a first layer; next paste or gum the back of the cloth, and, with this for the innermost layer, form a short tube, six inches long, with paper and paste, as before directed, using here not more than six thicknesses. The draw-tube will now be found to move easily and smoothly back and forth in this cloth-lined sheath; but, for fear that the gum or paste should have penetrated the cloth lining, and should stick the tube and its sheath together, it will be safer to draw them apart before drying, and thus save needless trouble and annoyance.

On comparing the external diameter of this sheath with the interior diameter of the large tube first made, it will be found that some packing is required, to hold the former steadily and concentrically within the latter. Take, therefore, some three-quarters inch strips of brown paper, and, having pasted them, wind around the sheath at each end, to form rings or collars of equal thickness, and large enough to fit snugly within the main tube. The appearance of the sheath when completed will be as shown in Fig. 1, where *a a'* are the collars just described.

Now take the compound object-glass, consisting of a double-convex crown-glass lens, A (Fig. 2), and a plano-convex flint-glass lens, B. They will come from the optician's shop separate, but loosely fitted into each other. Be careful to see that their several surfaces are bright

and free from specks, and, in handling them, touch only their edges. Remember, also, that the double-convex lens must be *outside* when the telescope is fitted up. Have ready a strip of tissue-paper, just the width of the thickness of the lenses at the edges: gum this on one side, and, holding the two lenses together with the fingers of the left

Fig. 1.

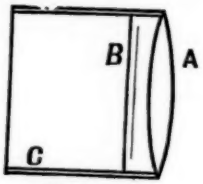

Fig. 2.

hand, wind the strip around the edges, so as to fix them together, and thus make a single piece which can be easily handled. When this is dry, take a strip of brown paper one and a quarter inch wide, and with paste form a short tube or cell, C, around the object-glass, using (say) five thicknesses. Fig. 2 shows the object-glass and cell in section.

To form the eye-piece: cut off a portion of the smallest tube—that on which the draw-tube was rolled—one and three-eighths inch in length, and make the ends even and *square*. Make, now, two disks of blackened cardboard, of the diameters respectively of seven-eighths inch and one inch. Punch or cut out exactly in the center of each disk an aperture one quarter inch in diameter. Gum the edges of the smaller disk, and fit it *into* the tube, exactly three quarters of an inch from one end, and, of course, five eighths of an inch from the other end. Then take the two-inch plano-convex lens, and, having made it perfectly clean, cement it on to the end of the tube nearest the perforated disk, with the plane surface inward. Use shellac varnish, or gold-size, for cementing the lens on to the edge of the tube. Cement the three-quarters inch plano-convex on to the one-inch perforated disk, centrally over the aperture, and with the plane surface next the card. When the cement on both lenses is dry, which will be in a day or two, fasten this one-inch disk to the open end of the tube, *keeping the lens inside.* A single layer of tissue-paper, gummed on to the outside of the tube, and turned down about one sixteenth of an inch all around the edge of the two-inch lens, and around the disk at the other end, will now serve as a sort of fastener to both, and will complete the eye-piece, which is shown in full size in section, Fig. 3. The smaller lens *a* must be next the eye when the telescope is fitted up; the larger lens *b*, called the field-glass, will be inside and facing the object-glass.

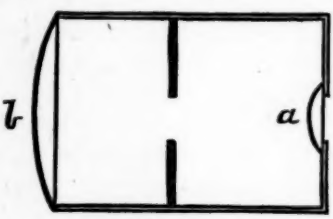

Fig. 3.

For fitting together the various parts now completed few directions

are needed. The cell containing the object-glass must first be slid into one end of the large tube, and made to fit neatly, by *even-wrapping* with tissue-paper or other soft material. The sheath (Fig. 1) must now be slid into the other end of the large tube, and fitted in a similar manner. Now push the draw-tube into the sheath, and slide the eye-piece about half-way into the end of the draw-tube, and the telescope is completed. Those who are æsthetically inclined may give an extra finish to the main tube, and also to the draw-tube and eye-piece, by using for the outermost layers gilt-paper, or other smooth and colored

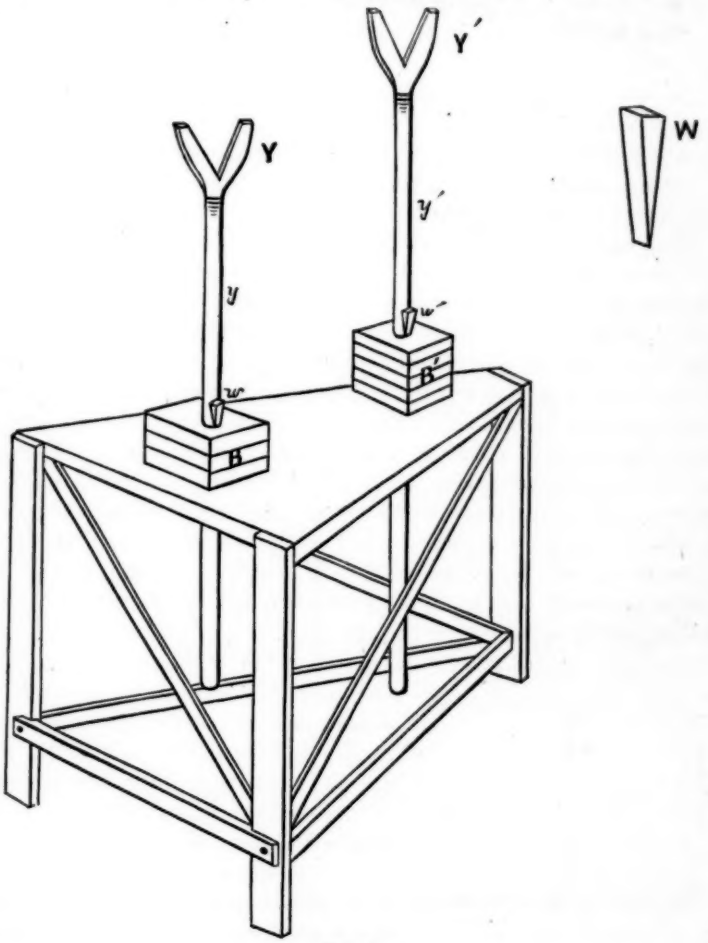

Fig. 4.

material. A sun-shade, consisting of a wide tube, three inches long, may also be made to slide over the object-end of the telescope ; and a cap may be added to this to keep out dust. A kind of cap, perforated with an aperture one quarter of an inch in diameter, may also be con-

structed for slipping over the eye-piece, so as to preserve the proper distance between the eye and the eye-lens when making observations; and a second similar cap should be made, and furnished with a disk of black or red glass, for protecting the eye when viewing the sun. For myself, I use a disk of thin microscopic glass, smoked and fastened in a cap which slips over the eye-piece.

But a telescope, even such as I have described, and which has a power of only twenty-five or twenty-six diameters, needs a stand, and this can be constructed easily and cheaply of one-inch pine and a few nails and screws, something after the pattern shown in Fig. 4. By laying the telescope on the two end-supports, Y Y′, greater steadiness is secured than by using a single support in the center; and the rods *y y′* are easily raised or lowered, and may be fixed in their positions by the little wedges *w w′*. The stand is thirty inches high, sixteen inches broad, and twenty-five inches long. The rods *y y′* are forty inches and sixty inches long respectively. The blocks B B′ are built up of pieces of one-inch board, nailed together; then an auger-hole is bored through the whole, so as to form a sheath or tube in which the rods may slide easily, but without so much lateral motion, or "wiggle," as they would have if they only passed through one thickness of board.

By following these directions you will have a really useful achromatic telescope; small, indeed, and insignificant when compared with the six-foot reflector of Lord Rosse, or with one of Clark's twenty-six-inch refractors; but, nevertheless, a veritable Jacob's ladder, by which you can ascend—if not *into*—at least twenty-five twenty-sixths of the way *toward* heaven; a perpetual source of pleasure, to a family of intelligent children, on moonlight nights and on occasions of eclipses; worth a whole year's "schooling" as an incentive and help to the study of the universe, and a practical realization of an answer to the oft-mouthed prayer—

"Nearer, my God, to thee!"

THE UTILITY OF SCHOOL-RECESSES.

By JOSEPH CARTER.

THERE is a growing tendency to abandon the school-recess. The editor of the Boston "Journal of Education" says of the no-recess experiment, adopted in Rochester, New York, that it has given "perfect satisfaction." Among the advantages gained, he mentions, "a continuous school-session without interruptions in school-work"; "better health of pupils, on account of freedom from exposure to cold and wet weather in the midst of each session"; "discipline easier, on

account of freedom from recess-troubles"; "more time for teachers," etc.; "less tardiness and absenteeism"; and less frequent opportunities for vicious pupils to come in contact with and corrupt other pupils." Believing that these reasons are unsatisfactory, and that the tendency is a bad one, I propose to offer some general considerations that weigh strongly against it.

The schools are utilitarian in their aim; to fit the child for living successfully is the object of their existence. As animal strength is the foundation of all moral and physical welfare, and is the chief condition of success in all the pursuits of life, the future welfare of the child in every way depends upon the normal development of his body.

An effeminate man is half sick; and when it comes to any of the severer trials of life, either physical or moral, where great endurance or courage is required, the weakest must inevitably be the first to succumb. This is as true of moral trials as of physical, for moral cowardice often results from physical feebleness. It is to be doubted if anything that is taught in the schools is of so much value to a child that it would not better be foregone than to be obtained by the loss of any physical vigor whatever. Taken in the truest sense, that city has the best schools where the school restraints have least effect upon the physical growth and normal development of the pupils, and not the one where the pupils show the greatest proficiency in acquiring in a *memoriter* way a few fragments of conventional facts which happen irrationally to pass current for an education. But because in so many schools the test to be applied at the end of the term, or at the end of the course, is the *memoriter* one, and because no teacher expects her pupils to be examined as to their health, or as to whether they are forming habits of life that will be conducive to healthfulness, it is not to be wondered at that all the plans of the teacher look more to the development of conventional proficiency than to the infinitely more important matter of health.

Under our present standard for successful teaching, it is a necessity that the teacher bend all her energies to the attainment of those things which are to be measured by a technical school examination, and that the matter of health be entirely ignored; in fact, it is a thing rather to be shunned, for, as a rule, the nervous, sallow-cheeked, flat-chested boy or girl, with the attenuated skeleton, will vanquish his more robust and healthful brother in one of these examination-jousts; and that teacher whose school contains the largest per cent of the former class may reasonably expect to obtain the greatest per cent from the examination by the superintendent. Hence it is that the "no-recess" plan will frequently meet with great favor among teachers who are most zealous and honest in doing their duty as they understand it.

There is already too strong a tendency, under our mode of civilization, to form troglodytic habits. This is shown by the number of

people who flock to the cities, by the number of boys who seek in-door employment, and by the prevalent sentiment that any person who is properly educated will secure something to do where he may stay in the shade and away from the weather. That the abandonment of the out-door recess in our schools will strengthen this tendency to an in-door life, and weaken the disposition, born with every child having a normal development, to get out-of-doors, can not be doubted. That this "no-recess" plan is in direct opposition to all the instincts of the child's nature, ought to insure its immediate condemnation.

Muscular action for the health of a growing child is a necessity, and the amount of exercise that a child will take, when permitted to roam out-of-doors with congenial company at his own sweet will, is a quantity of vast magnitude. Muscular action is and should be a thing for which the child has an appetite, a craving, as intense as any he ever feels for food or fruit, and no school discipline should be allowed to interfere with its necessary gratification. The play-ground is more of a necessity to a school of young children than any of the other school appliances.

Recognizing the violence that the no-recess plan is doing to the future well-being of their pupils, some superintendents have invented a series of in-door games, which are played for a few minutes, at short intervals, in the school-room, under the charge of the teacher, such as tossing little bags of beans, marching, exercises with the arms and legs, and the like. The best of such exercises fall very far short of the real, soul-stirring, cheek-glowing, muscle and brain making exercise of the play-ground; while the poorest of them—and all are poor when they take the place of the open-air recess—are the severest trial of the day, both to the nerves and the amiability of teacher and pupils. As a rule, there is no other school exercise in which there is so much friction between teacher and pupils, none other where so frequent appeals are made to higher authority, and none other from which the pupil so often tries to escape, as this gymnastics. The law of physics, that all bodies move in the direction of least resistance, ought to show teachers that this plan, in its present form, should be abandoned. Children do not like to be marched around under the direction of a teacher who needs the exercise more than they, and who sits or stands still while they are marching. During a five years' military service, the hardest campaign I went through was a three months' drill, and I never saw a regiment but would sooner undertake a week of severest marching than a week of camp-drilling. That gymnastics can be, and sometimes is, made of great benefit to the pupils, is true, but the teachers who have the skill, ability, and enthusiasm requisite for the work are very rare. Children have a desire to manage for themselves. How often do we observe their impatience at our opening some box or package of theirs that they wish to open for themselves! And, if the teacher were competent to enter thoroughly into

the spirit of the in-door game, the children would still prefer to manage it in their own way.

But if the exercise in the house, so far as muscular action is concerned, answered every purpose, it would still be unwise, because it begets the habit of in-door life, and this is destructive of all educational development except in a few very narrow lines, and it is questionable if these lines are educational in any true sense. A child with the in-door habit may be an adept at parsing, he may be skillful in translating Latin and Greek, and be able to follow in the beaten track of mathematics; but when it comes to any of the sciences, when he attempts any of the studies which relate to the phenomena of the living world, or of the objective world about him, because he has never observed these phenomena himself, he will fail. He will fail because in what he has seen and experienced there is nothing by which he will be able to translate to himself the words or the pictures of the text-book. In all the branches of natural history he can learn nothing but the words of the book. What the science of chromatics would be to a blind child, or acoustics to a deaf one, is the greater part of our science-teaching, in cities especially, to the boys and girls—Kaspar Hausers—whose life is spent in the house. Knowing so little of the phenomena of the world, they are, of course, unable to comprehend any of the grand generalizations which follow a knowledge of their causes and sequences; and, being deprived of this, they are without both the powers of observation and of the deeper reasoning which can come only as a result of facts obtained by observations of their own and kindred ones of others. To teach such children text-book science is not only a waste of the time of the child, but it is a very great damage to him, both because it will have a stultifying effect upon his mental powers, and because it will make him believe—if he learns the words and secures a fair per cent from his teacher—that he has an understanding of the subject, when, as a matter of fact, he knows nothing of it but the words in which the thoughts are expressed, while the very existence of the true thoughts is all unknown to him.

To speak of the advantages of an out-of-door life seems almost like stating truisms universally accepted; and yet the great mortality among the dwellers in-doors, their precarious tenure of life, the prevalence of nervous diseases among them, and the tendency to crime, all show that it is still necessary to refer to the ruddy health of the farmer, to his greatly prolonged life, to his freedom from insomnia, to his immunity from pulmonary complaints, and to his absence both from the prison and the almshouse, as a proof that out-door life is necessary to health and to happiness. The tendency of book-learning, under the most favorable conditions, is to too much in-door life, and, when this tendency receives the additional influence of the no-recess plan, it certainly has a powerful hold upon the young person just emerging from the school-room. Is Solomon's injunction, to "train up a child in the way he

should go," sufficiently heeded? Dr. Oswald says: "Early impressions are very enduring, and can make evil habits as well as useful ones a sort of second nature. In order to forestall the chief danger of an in-door life, make your children love-sick for fresh air; make them associate the idea of fusty rooms with prison-life, punishment, and sickness." So at school, the deprivation of the regular recess ought to be as severe a punishment as the criminal code of the school permits, and to be sent to the school-room from the play-ground should be a sufficient penalty for the worst offense, and is a punishment that should be administered to the juvenile offender only for offenses of a nature similar to those which in the adult offender are punished by incarceration in the jail or bridewell.

Our physical constitution was never intended for the sluggish inactivity of our sedentary and bookish school-life, and we sin against the laws of our being when we forego necessary physical exercise. Sloth is not one of our original sins, but an acquired one, and perhaps in no other place is its acquisition so rapid as in a modern school-room, where pencils and paper are passed to the pupils, and every movement must be quiet, subdued, and noiseless, and where the temperature is kept at a uniform degree, so that not even the involuntary muscles get any exercise. When along with this condition come the multitude of studies pursued, and the pressure of emulation, and upon all the abolition of the regular play-spell, what is there to prevent the boys and girls from forming the most fatal habits of muscular indolence? A recent writer in the "Monthly" says: "Where the chief danger seems to lie, in most schools, is in the encroachment made on the play-hours. In some schools the lessons set to be learned at home are absurdly long and tedious. I find that in other schools, public and private, a great deal of work is done during the period nominally allotted to recreation only. This is a very important part of the actual school system, and one which requires great care on the part of the masters" ("Science Monthly," March, 1880). In a school of eighty pupils, with ages ranging from twelve to fifteen years, each pupil counted his pulsations for one minute immediately before and after a fifteen minutes' recess, and recorded each result upon a card; the recess was varied, sometimes an out-door, sometimes an in-door, with light gymnastics, and sometimes the pupils were advised to follow their own inclination in the matter, but always to record upon the card how the recess was passed. These are some of the general averages:

1. Those pupils who go out and engage in play increase the number of pulsations per minute by 13·4. 2. Those who engage in in-door gymnastics increase the number by 3. 3. Those who stay in the school-room at their seats, or visiting their neighbors, decrease their number by 3·8. This increase of number of pulsations from the recess-play is by no means the full measure of the benefit derived, for that increase

implies a more rapid flow of the fluid through the hemal channels, and, when we know that the carrying power of fluid currents increases as the sixth power of their velocities, we can appreciate with how much greater force these currents sweep through their courses, washing away the ashes, which have been made by previous combustion, from the brain-hearth and the muscle-hearth. To the child who has been busily engaged upon his lessons, it frequently happens that the further ability to accomplish mental work successfully, and without nervous debility, depends upon the thorough removal of the *débris* caused by cerebral exercise. When this removal has been accomplished by recreation, the child's power has been recreated. That pupils generally do their best school-work just after recess, and that they are less "nervous" at that time, is because the exercise has increased their nerve-power, and given them a better control of their intellectual faculties, and a greater willingness to do hard thinking. Muscular exercise, then, becomes a motive power for driving forward the machinery of thought.

Were there no other objection to this plan, the one that it keeps children away from the sunlight would still be enough to condemn it. When we see the boys and girls of this country gathering at the call of the school-bell at 9 A. M. and remaining till 4 P. M., away from the sunlight—except a few minutes' walk to and from dinner—and this continued from six to sixteen years of age, for five days in a week and ten months in a year, how can we help fearing that this school-life, however good it may be in other respects, can not fail to leave its pupils with emaciated bodies, attenuated limbs, and with a general strength much below the average of what it should be, and much below the average of what it must be, in order to give them that start in the struggle for existence which they must have if they would win; it is not possible to save them from this competition; all must meet it, and the power of physical endurance is an absolute necessity for success.

Neither Latin, Greek, grammar, nor geography, can give this power; but an hour's play in the sunshine daily, for this ten years of school-life, might do so.

Not only do the out-door recesses have the advantage of air and sunshine in good weather, but in bad weather they have the advantage of exposure also; and, contrary to the commonly accepted theories, exposure to inclement weather, in a reasonable degree and with proper care, is of very great advantage. For nine years past it has been my invariable practice, at four different periods daily, for a time aggregating ninety minutes, to supervise a play-ground where several hundred children of a public school assemble. I have observed that there are certain ones, some of each sex, who are seldom absent. No cold, except, perhaps, half a dozen days of the severest, and no storm except a most drenching rain, ever drives them into their school-rooms. Through all ordinary rains and snows they seem to feel no discomfort.

With lists of the names of these I have examined the registers of daily attendance kept by the teachers, and, upon making out lists of their absences from school on account of sickness, find their per cent is not one fifth as great as that of the whole school, and not one twelfth as great as that of an equal number of pupils of the same grade who are never seen upon the play-ground in either good or bad weather.

At first sight these figures seem inexplicable; but when any one looks about his own town and sees families of laboring-men with half a dozen children to each house, and sees their houses are poorly built, that they admit the wind and sometimes the rain, he sees the children running about in quite frosty weather barefoot, he sees them playing in the rain and storm with perfect freedom from colds, and he knows they are seldom sick—then if he looks up the avenue to some residence with its double windows, its base-burner, which keeps the house at a uniform temperature, and observes when the children come out how carefully they are protected from the weather, and how very delicate they are, he will, if he is thoughtful, soon conclude that the good health of the children of the laboring-man is because they encounter exposure, and not that they encounter exposure because of their good health.

Where school-rooms are warmed by an abundance of pure, warm air, and where pupils have perfect liberty to go at any time to the registers to warm and dry shoes and clothing, they will not suffer by any voluntary out-door exposure, however inclement the weather. There seem to be no other gymnastics for the involuntary muscles, those controlling the vital functions of respiration and circulation, but exposure and vigorous exercise. Who has ever heard a hale old man, who had long since passed his allotted halting-place of threescore-and-ten, tell of his youth, but could tell of exposure, constant and severe, in his youth? Hunters, wood-choppers, ranchers, and soldiers, are not afraid of the weather, nor are they subject to coughs and colds. During five years of army life as a trooper, our regiment was never in barracks, and much of the time was without tents. Often we were wet to the skin, and sat our horses till our clothes dried upon us by the heat from our bodies without feeling any other effect than an increased appetite. By exposure we were made water-proof; and I believe children can be made largely cold-proof, and sickness-proof, by allowing them their own free-wills as to exposure.

Children need the rough-and-tumble of an out-door recess to toughen the sinews of the body. Many at home are so tenderly cared for that, what with cushioned chairs, stuffed sofas, and spring-seats to the very carriages in which they ride to school, they are in danger of becoming too tender for even this usage; and, if they are ever to accomplish anything in this world, they must somewhere acquire the physical power to endure many hard knocks in the various ways and sta-

tions of life. They can not always be held in their nurses' arms. They will meet with accidents which, if they are accustomed to the games of the play-ground, will not affect them at all, but which, if they are not, will lay them up with a lame side, a sprained ankle, or a dislocated joint. Falls and tumbles occur daily upon the play-ground, with no injurious effects whatever, which would put some of the tenderly nurtured in bed for a week. The play-ground is the only place connected with the schools where children can become hardy: and this element of hardiness has been very strongly marked in all successful men. It is not the carpet-knights who to-day rule in politics or in business—no, nor in science or religion—but the men who have grit and toughness, men who fear neither ridicule nor a crowd of rowdies.

Take the boy who has a few companions to play with him upon his own lawn, and who, like himself, are carefully kept from the society of the rougher and more world-wise boys of the street, and how is he to get any knowledge of the methods or the power by which these others are to be controlled in after-life? Yet this boy and his class are those who in many respects ought to have a controlling influence on the destiny of his neighborhood, but, because he has no acquaintance with the other class, because he does not know what are their ruling motives, he is powerless for good among them. By means of this knowledge those agitators among the people, like Moody and Dennis Kearny, the leading politician in each town and ward, and the organizers of strikes, have such power among the masses; and their lack of this knowledge is the main cause of failure of our citizens' social-reform societies and kindred organizations which attempt some very laudable reforms. As the boy is father to the man, so the play-ground is the antecedent of the future society of the town or ward, and upon the play-ground, more than in the school-room, the leaders of the future are made; there the boy must learn, if he ever learn it, how to lead, control, and master the others—boys to-day, but men to-morrow. The school-room is an autocracy, with the teacher for autocrat and the pupils for subjects, but the play-ground is a pure democracy: there each, in proportion to his strength, dexterity, and skill, is equal to any other; there the egotist learns his insignificance, the rude boy gets his first lessons in common courtesy, and there the bully learns that his ways are not approved.

But the ruling sentiment of the play-ground must not be allowed to form itself by accident: children must not be left to themselves at these times.

An out-door recess needs the controlling presence of the teacher quite as much as an in-door one, and more than the ordinary exercise of the school-room, and because this has been neglected is the reason why some people have objected to it. Several hundred children, after experiencing the restraint of the school-room, should not be released upon the play-ground without supervision competent to suppress what-

ever may appear that is pernicious. There is no other time in all the day when competent guidance can do so much to make boys manly and girls womanly as when they are at their games. It is not enough to leave the play-ground to the janitor or to some inferior authority; it is the place where the principal teacher and nearly all the others are most needed—not to direct the games, or to meddle in any way with the sports, but to be ready with a cheery voice and an easy grace to suggest to any one about to engage in anything improper that he has forgotten himself. Ruffianism will soon disappear, timid children will learn to assert themselves, and an *esprit de corps* of the play-ground can soon be formed which will have a wonderful influence on the characters as well as the actions of the pupils. Nor is the benefit to the pupils all that is derived from this plan; the teacher needs such a recess quite as much as, and in many cases more than, her pupils. Fifteen minutes of each ninety in the open air, away from the sights and thoughts of the lessons, will remove the nervous, tired, irritable, and almost despondent feeling experienced by many teachers, and give them renewed strength and cheerfulness and mental elasticity for the remainder of the session. By being upon the play-ground among her pupils, many a teacher learns their character, their ambitions, the bent of their minds, as she can not learn them in the peculiar position in the school-room; and yet there are many children who, unless understood in these particulars, can not be successfully taught. To the teacher who sees her pupils only in their relation of pupils, the school-work is very likely to become a grind, a machine at which she is to perform a regular and a constant part, and the children are little else than so much raw material which is to pass through the mill over which she presides. She sees no individuality in them, and of course her work is arranged for the aggregate, and individuals receive no consideration as such. To overcome this error there is nothing better than for her to see them daily at their sports, for there their distinctive characteristics are manifested as in no other place. If the schools are to build character, certainly an out-door recess is an absolute essential for both teacher and pupils.

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

XVI.

A CORRESPONDENT of Manchester asks me which is the most nutritious, a slice of English beef in its own gravy, or the browned morsel as served in an Italian restaurant with the burnt-sugar addition to the gravy?

This is a very fair question, and not difficult to answer. If both are equally cooked, neither over-done nor under-done, they must contain, weight for weight, exactly the same constituents in equally digestible form, so far as chemical composition is concerned. Whether they will actually be digested with equal facility and assimilated with equal completeness depends upon something else not measurable by chemical analysis, viz., the relish with which they are respectively eaten. To some persons the undisguised fleshiness of the English slice, especially if under-done, is very repugnant. To these the corresponding morsel, cooked according to Francatelli rather than Mrs. Beeton, would be more nutritious. To the carnivorous John Bull, who regards such dishes as "nasty French messes" of questionable composition, the slice of unmistakable ox-flesh from a visible joint would obtain all the advantages of appreciative mastication and that sympathy between the brain and the stomach which is so powerful that, when discordantly exerted, may produce the effects that are recorded in the case of the sporting traveler who was invited by a Red Indian chief to a "dog-fight," and ate with relish the savory dishes at what he supposed to be a preliminary banquet. Digestion was tranquilly and healthfully proceeding, under the soothing influence of the calumet, when he asked the chief when the fight would commence. On being told that it was over, and that in the final *ragoût* he had praised so highly the last puppy-dog possessed by the tribe had been cooked in his honor, the normal course of digestion of the honored guest was completely reversed.

Reverting to the fat used in frying, and the necessity of its purification, I may illustrate the principle on which it should be conducted by describing the method adopted in the refining of mineral oils, such as petroleum or the paraffin distillates of bituminous shales. These are dark, tarry liquids of treacle-like consistency, with a strong and offensive odor. Nevertheless, they are, at but little cost, converted into the "crystal-oil" used for lamps, and that beautiful pearly substance, the solid, translucent paraffin now so largely used in the manufacture of candles. Besides these, we obtain from the same dirty source an intermediate substance, the well-known "*vaseline*," now becoming the basis of most of the ointments of the pharmacopœia. This purification is effected by agitation with sulphuric acid, which partly carbonizes and partly combines with the impurities, and separates them in the form of a foul and acrid black mess, known technically as "acid tar." When I was engaged in the distillation of cannel and shale in Flintshire, this acid tar was a terrible bugbear. It found its way mysteriously into the Alyn River, and poisoned the trout; but now, if I am correctly informed, the Scotch manufacturers have turned it to profitable account.

Animal fat and vegetable oils are similarly purified. Very objectionable refuse fat of various kinds is thus made into tallow, or mate-

rial for the soap-maker, and grease for lubricating machinery. Unsavory stories have been told about the manufacture of butter from Thames mud or the nodules of fat that are gathered therefrom by the mud-larks, but they are all false. It may be possible to purify fatty matter from the foulest of admixtures, and do this so completely as to produce a soft, tasteless fat, i. e., a butter substitute, but such a curiosity would cost more than half a crown per pound, and therefore the market is safe, especially as the degree of purification required for soap-making and machinery-grease costs but little, and the demand for such fat is very great.

These methods of purification are not available in the kitchen, as oil of vitriol is a vicious compound. During the siege of Paris some of the Academicians devoted themselves very earnestly to the subject of the purification of fat in order to produce what they termed "siege-butter" from the refuse of slaughter-houses, etc., and edible salad oils from crude colza oil, the rancid fish oils used by the leather-dresser, etc. Those who are specially interested in the subject may find some curious papers in the "Comptes Rendus" of that period. In vol. lxxi, page 36, M. Boillot describes his method of mixing kitchen-stuff and other refuse fat with lime-water, agitating the mixture when heated, and then neutralizing with an acid. The product thus obtained is described as admirably adapted for culinary operations, and the method is applicable to the purpose here under consideration.

Further on in the same volume is a "Note on Suets and Alimentary Fats" by M. Dubrunfaut, who tells us that the most tainted of alimentary fats and rancid oils may be deprived of their bad odors by "appropriate frying." His method is to raise the temperature of the fat to 140° to 150° Centigrade (284° to 302° Fahr.) in a frying-pan; then cautiously sprinkle upon it small quantities of water. The steam carries off the volatile fatty acids producing the rancidity in such as fish-oils, and also the neutral offensive fatty matters that are decomposed by the heat. In another paper by M. Fua this method is applied to the removal of cellular tissue of crude fats from slaughter-houses. It is really nothing more than the old farm-house proceeding of "rendering" lard, by frying the membranous fat until the membranous matter is browned and aggregated into small nodules, which constitute the "scratchings"—a delicacy greatly relished by our British plowboys at pig-killing time, but rather too rich in pork-fat to supply a suitable meal for people of sedentary vocations.

The action of heat thus applied and long continued is similar to that of the strong sulphuric acid. The impurities of the fat are organic matters more easily decomposable than the fat itself, or, otherwise stated, they are dissociated into carbon and water at about 300° Fahr., which is a lower temperature than that required for the dissociation of the pure oil or fat (see No. 13 of this series). By maintaining this temperature, these compounds become first caramelized, then carbon-

ized nearly to blackness, and all their powers of offensiveness vanish, as such offense is due to slow decomposition of the original organic compounds, which now exist no longer, and the remaining caramel or carbon cinders being quite inoffensive or no further decomposable by atmospheric agency.

In the more violent factory process of purification by sulphuric acid the similar action which occurs is due to the powerful affinity of this acid for water; this may be strikingly shown by adding to thick sirup or pounded sugar about its own bulk of oil of vitriol, when a marvelous commotion occurs, and a magnified black cinder is produced by the separation of the water from the sugar.

The following simple practical formula may be reduced from these data. When a considerable quantity of much-used frying fat is accumulated, heat it to about 300° Fahr., as indicated by the crackling of water when sprinkled on it, or, better still, by a properly constructed kitchen thermometer graduated to about 400° Fahr. Then pour the melted fat on hot water. This must be done carefully, as a large quantity of fat at 400° poured upon a small quantity of boiling water will illustrate the fact that water when suddenly heated is an explosive compound. The quantity of water should exceed that of the fat, and the pouring be done gradually. Then agitate the fat and water together, and, if the operator is sufficiently skillful and intelligent, the purification may be carried further by carefully boiling the water under the fat, and allowing its steam to pass through; but this is a little dangerous, on account of the possibility of what the practical chemist calls "bumping," or the sudden formation of a big bubble of steam that would kick a good deal of the superabundant fat into the fire.

Whether this supplementary boiling is carried out or not, the fat and the water should be left together to cool gradually, when a dark layer of carbonized impurities will be found resting on the surface of the water, and adhering to the bottom of the cake of fat. This may be peeled off and put into the waste grease-pot, to be further refined with the next operation. Ultimately the worst of it will sink to the bottom of the water. Then it is of no further value, and will be found to be a mere cinder.

XVII.

Regarding the fat used in frying as a medium for conveying heat, freedom from any special flavor of its own is a primary desideratum. Olive-oil of the best quality is almost absolutely tasteless, and, having as high a boiling-point as animal fats, it is the best of all frying media. In this country there is a prejudice against the use of such oil. I have noticed at some of those humble but most useful establishments where poor people are supplied with penny or twopenny portions of good fish, better cooked than in the majority of "eligible villa residences," that

in the front is an inscription stating that "only the best beef-dripping is used in this establishment." This means a repudiation of oil. Such oil as has been supplied for fish-frying may well be repudiated.

On my first visit to arctic Norway I arrived before the garnering and exportation of the spring cod harvest was completed. The packet stopped at a score or so of stations on the Lofodens and the mainland. Foggy weather was no impediment, as an experienced pilot free from catarrh could steer direct to the harbor by "following his nose." Huge caldrons stood by the shore in which were stewing the last batches of the livers of cod-fish caught a month before and exposed in the mean time to the continuous arctic sunshine. Their condition must be imagined, as I abstain from description of details. The business then proceeding was the extraction of the oil from these livers. It is, of course, "cod-liver oil," but is known commercially as "fish-oil," or "cod-oil." That which is sold by our druggists as cod-liver oil is described in Norway as "medicine-oil," and though prepared from the same raw material, is extracted in a different manner. Only fresh livers are used for this, and the best quality, the "cold-drawn" oil, is obtained by pressing the livers without stewing. Those who are unfortunately familiar with this carefully prepared, highly refined product, know that the fishy flavor clings to it so pertinaciously that all attempts to completely remove it without decomposing the oil have failed. This being the case, it is easily understood that the fish-oil stewed so crudely out of the putrid or semi-putrid livers must be nauseous indeed. I am told that it has nevertheless been used by some of the fish-fryers, and I know that refuse "Gallipoli" (olive-oil of the worst quality) is sold for this purpose. The oil obtained in the course of salting sardines, herrings, etc., has also been used.

Such being the case, it is not surprising that the use of oil for frying should, like the oil itself, be in bad odor.

I dwell upon this because we are probably on what, if a fine writer, I should call the "eve of a great revolution" in respect to frying media.

Two new materials, pure, tasteless, and so cheap as to be capable of pushing pig-fat (lard) out of the market, have recently been introduced. These are cotton-seed oil and poppy-seed oil. The first has been for some time in the market offered for sale under various fictitious names, which I will not reveal, as I refuse to become a medium for the advertisement of anything—however good in itself—that is sold under false pretenses. If the lamp of KNOWLEDGE, more fortunate than that of Diogenes, should light upon some honest men who will retail cotton-seed oil as cotton-seed oil, I shall gladly (with the editor's permission) do a little straightforward touting for them, as they will be public benefactors, greatly aiding the present movement for the extension of the use of fish-food.

As every bale of cotton yields half a ton of seed, and every ton of

seed may be made to yield twenty-eight to thirty-two pounds of crude oil, the available quantity is very great. At present only a small quantity is made, the surplus seed being used as manure. Its fertilizing value would not be diminished by removing the oil, which is only a hydro-carbon, i. e., material supplied by air and water. All the fertilizing constituents of the seed are left behind in the oil-cake from which the oil has been pressed.

Hitherto cotton-seed oil has fallen among thieves. It is used as an adulterant of olive-oil; sardines and pilchards are packed in it. The sardine trade has declined lately, some say from deficient supplies of the fish. I suspect that there has been a decline in the demand, due to the substitution of this oil for that of the olive. Many people who formerly enjoyed sardines no longer care for them, and they do not know why. The substitution of cotton-seed oil explains this in most cases. It is not rancid, has no decided flavor, but still is unpleasant when eaten raw, as with salads or sardines. It has a flat, cold character, and an after-taste that is faintly suggestive of castor-oil; but faint as it is, it interferes with the demand for a purely luxurious article of food. This delicate defect is quite inappreciable in the results of its use as a frying medium. The very best lard or ordinary kitchen butter, eaten cold, has more of objectionable flavor than refined cotton-seed oil.

I have not tasted poppy-seed oil, but am told that it is similar to that from the cotton-seed. As regards the quantities available, some idea may be formed by plucking a ripe head from a garden poppy and shaking out the little round seeds through the windows on the top. Those who have not tried this will be astonished at the numbers produced by each flower. As poppies are largely cultivated for the production of opium, and the yield of the drug itself by each plant is very small, the supplies of oil may be considerable; 571,542 cwt. of seeds were exported from India last year, of which 346,031 cwt. went to France.

Palm-oil, though at present practically unknown in the kitchen, may easily become an esteemed material for the frying-kettle (I say "kettle," as the ordinary English frying-pan is only fit for the cooking of such things as barley bannocks, pancakes, fladbrod, or oat-cakes). At present, the familiar uses of palm-oil in candle-making and for railway grease will cause my suggestion to shock the nerves of many delicate people, but these should remember that before palm-oil was imported at all, the material from which candles and soap were made, and by which cart-wheels and heavy machinery were greased, was tallow—i. e., the fat of mutton and beef. The reason why our grandmothers did not use candles when short of dripping or suet was that the mutton-fat constituting the candle was impure; so are the yellow candles and yellow grease in the axle-boxes of the railway carriages. This vegetable fat is quite as inoffensive in itself, quite as

wholesome, and—sentimentally regarded—less objectionable, than the fat obtained from the carcass of a slaughtered animal.

When common sense and true sentiment supplant mere unreasoning prejudice, vegetable oils and vegetable fats will largely supplant those of animal origin in every element of our dietary. We are but just beginning to understand them. Chevreul, who was the first to teach us the chemistry of fats, is still living, and we are only learning how to make butter (not "inferior Dorset," but "choice Normandy") without the aid of dairy produce. There is, therefore, good reason for anticipating that the inexhaustible supplies of oil obtainable from the vegetable world—especially from tropical vegetation—will ere long be freely available for kitchen uses, and the now popular product of the Chicago hog factories will be altogether banished therefrom, and used only for greasing cart-wheels and other machinery.

As a practical conclusion of this part of my subject, I will quote from this month's number of "The Oil Trade Review" the current wholesale prices of some of the oils possibly available for frying purposes. *Olive-oil*, from £43 to £90 per ton of 252 gallons; *Cod-oil*, £36 per ton; *Sardine or train* (i. e., the oil that drains from pilchards, herrings, sardines, etc., when salted), £27 10*s.* to £28 per ton. *Cocoa-nut*, from £35 to £38 per ton of 20 cwt. (This, in the case of oil, is nearly the same as the measured ton.) *Palm*, from £38 to £40 10*s.* per ton; *Palm-nut or copra*, £31 10*s.* per ton; *Refined cotton-seed*, £30 10*s.* to £31 per ton; *Lard*, £53 to £55 per ton. The above are the extreme ranges of each class. I have not copied the technical names and prices of the intermediate varieties. One penny per pound is = £9 6*s.* 8*d.* per ton, or, in round numbers, £1 per ton may be reckoned as one ninth of a penny per pound. Thus the present price of best refined cotton-seed oil is 3½*d.* per pound; of cocoanut-oil, 3⅝*d.*; palm-oil, from 3½*d.* to 4½*d.*, while lard costs 6*d.* per pound wholesale—usually 7*d.*

I should add, in reference to the seed-oils, that there is a possible objection to their use as frying media. Oils extracted from seeds contain more or less of *linoleine* (so named from its abundance in linseed-oil), which, when exposed to the air, combines with oxygen, swells and dries. If the oil from cotton-seed or poppy-seed contains too much of this, it will thicken inconveniently when kept for a length of time exposed to the air. Palm-oil is practically free from it, but I am doubtful respecting palm-nut-oil, as most of the nut-oils are "driers."—*Knowledge.*

SKETCH OF LAMARCK.

THERE are two classes of scholars. Those of the one class, who travel in the footsteps of their predecessors, increase the domain of knowledge, and add new discoveries to those that were made before them; their labors are immediately appreciated, and they enjoy their well-earned fame in full measure. Others, who leave the trodden ways, emancipate themselves from traditions, and expose to the light of the sun the germs of future discovery which lie buried in the teachings of the present. Sometimes they are appreciated at their full value during their lifetime, but more frequently they pass away, misunderstood by the scientific public of their time, which is incapable of comprehending and following them. Indolence, routine, and ignorance oppose an invincible resistance against them during their career, and they die isolated and forsaken. In the mean time, science advances, facts increase, methods are perfected, and their contemporaries who survive them gradually come up to the mark they had left. Then all their forgotten services are brought into the light, justice is partly done to their labors, their genius is admired, it is recognized that they foresaw the future, and a tardy posthumous fame comforts their pupils for the neglect which the masters had to endure during the years of vain struggle for the triumph of the truth.

Lamarck belonged to both of these classes. By his descriptive labors in botany and zoölogy, and by the improvements which he introduced in the classification of animals, and which were accepted by his contemporaries, he gained a first place among the naturalists of his time; but his philosophical views on organic beings in general were rejected, and did not even enjoy the honor of a sincere testing. They were only accorded a polite silence, or treated with scornful irony.

Jean Baptist Pierre Antoine de Monet, known as the Chevalier de Lamarck, was born on the 1st of August, 1744, at Bazentin, a little town between Albert and Bapaume, in Picardy. He was the eleventh child of Pierre de Monet, lord of the manor, who was descended from an old family in the county Béarn, and called only a small hereditary estate his own. His father had designed him for the church, then the common destination for the younger sons of noble families, and took him to the Jesuit college at Amiens. This, however, was not the natural vocation of our young nobleman. Everything in his family associations inclined his mind toward military fame. His eldest brother had fallen in the breach at the siege of Berg-op-Zoom; the other two brothers were still in the service, while France was exhausting its forces in an unequal contest. His father opposed his wishes on this point; but, when the father died, Lamarck, following his own inclina-

tion, betook himself on a poor horse to the army, which was encamped near Lippstadt, in Westphalia. He was furnished with a letter of introduction from Frau von Lameth, proprietor of a neighboring estate, to Colonel de Lastic, of the Beaujolais regiment. This officer, when he saw the seventeen-year-old youth, who looked much younger, sent him to his quarters. A battle took place on the next day. M. de Lastic drew up his regiment, and noticed his *protégé* in the front rank of a company of grenadiers. The French army was under the command of Marshal Broglie and Prince Soubise while the allied troops were commanded by Prince Ferdinand of Brunswick. The two French officers, who did not agree together, were killed. The company Lamarck had joined was broken up by the enemy's fire, and was forgotten in the confusion of the retreat. The officers and under-officers were killed, and only fourteen were left standing. The oldest of these counseled retreat; Lamarck, who had, on the spur of the moment, improvised himself to the command, answered: "We have been assigned to this position, and we must not forsake it till we are relieved." The colonel, who now remarked that the company was not with his regiment, recalled it by an order which he managed to get back to it by a secret way. On the next day Lamarck was appointed an officer, and soon afterward a lieutenant. Fortunately for science, this brilliant beginning of a military career was not decisive of the future of the youth. After the conclusion of peace he performed garrison duty in Toulon and Monaco, till an inflammation of the lymphatic glands of the neck made it necessary for him to go to Paris to undergo an operation by Tenon, the scar of which he carried all his life.

The aspect of the vegetation in the neighborhood of Toulon and Monaco had attracted the attention of the young officer, who had already acquired some knowledge of botany from the "Traité des plantes usuelles" of Chomel. After he withdrew from the military service and had been awarded a modest pension of four hundred francs, he became engaged with a banker in Paris. Moved by an irresistible impulse to the study of Nature, he observed from his attic-room the forms and movements of the clouds, and made himself acquainted with plants in the royal gardens, and by means of botanical excursions. He felt that he was on the right way, and recalled Voltaire's judgment on Condorcet, that discoveries to come would secure him more fame with posterity than a company of soldiers. Dissatisfied with the botanical systems in use, he wrote in a half-year his "Flore française," and published his "Clé dichotomique," by the aid of which it is easy for a beginner to ascertain the name of the plants he is accustomed to see. This was in 1778. Through Rousseau botany became a fashionable study; the lords and ladies of the world of society busied themselves with plants; Buffon had the three volumes of the "Flore française" published at the Royal Printing-House; and in the next year

Lamarck entered the Academy of Sciences. Buffon, who wished his son to travel, gave him Lamarck as a conductor, with a commission from the government. They journeyed through Holland, Germany, and Hungary, and Lamarck became acquainted with Gleditsch in Berlin, Jaquin in Vienna, and Murray in Göttingen.

The "Encyclopédie methodique," begun by d'Alembert and Diderot, was not yet finished. Lamarck composed four volumes of this work, and in them described all the then known plants the names of which begin with the letters from A to P—a huge work, which was completed by Poiret, and included twelve volumes, appearing between 1783 and 1817. A still more important work, which also forms a part of the "Encyclopædia," and is continually quoted by botanists, is entitled "Illustration des genres" ("Illustration of Genera"), in which Lamarck described the characteristics of two thousand species. The work, says the title-page, is illustrated with nine hundred copper-plate engravings. Only a botanist can form a conception of the researches in herbaria, gardens, and books, which such an undertaking demanded. Lamarck accomplished it all by means of the most restless industry. If a traveler came to Paris, he was the first one to announce himself to him. Sonnerat returned from India with immense collections. Nobody but Lamarck took the trouble to look at them, and Sonnerat was so pleased with him for this that he presented the splendid herbarium to him. In spite of his indefatigable labors, Lamarck's situation was miserable enough. He lived by his pen, and in the service of the book-sellers. Even the petty position of overseer of the Royal Herbarium was refused him. Like the majority of naturalists, he contended for many years with the difficulties of life. A fortunate circumstance, which gave his activity another direction, brought improvement in his condition. The convent ruled over France. Carnot organized victory. Lamarck undertook to organize the sciences. The Museum of Natural History was founded upon his motion. They had been able to name professors for all the branches except zoölogy; but, in those times of ardent enthusiasm, France found warriors and men of science wherever it needed them. Étienne Geoffroy Saint-Hilaire was twenty-one years old, and was engaged with Haity in mineralogy. Daubenton said to him: "I take the responsibility for your inexperience upon myself; I have the authority of a father over you. Be so bold as to assume the chair of zoölogy, and it may be said some day that you have made a French science of it." Geoffroy acceded, and undertook the higher animals. Lakanal had well comprehended that a single professor would not be adequate to the task of working out the whole animal kingdom. Since the classification of the vertebrates only was taken care of by Saint-Hilaire, the whole list of invertebrates, including the insects, mollusks, worms, zoöphytes, etc., still remained in chaos—in the unknown. Lamarck, says Michelet, undertook the unknown. He had busied himself a little, under Bruguières's

direction, with the mollusks, but he still had nearly all to learn, or, to speak more accurately, nearly all to create, in that uninvestigated world in which Linnæus had failed to introduce the methodical arrangement which he had been so successful in introducing among the higher animals. After devoting a year to preliminary studies, Lamarck began his lectures in the Museum in the spring of 1794; he immediately instituted the great division of animals into vertebrates and invertebrates, which has become fixed in science. Adhering to the Linnæan division of the vertebrates into mammalia, birds, reptiles, and fishes, he divided the invertebrates into mollusks, insects, worms, echinoderms, and polyps. In 1799 he separated the order of crustaceans from the insects with which it had been confounded; in 1800 he separated the arachnids from the insects; in 1802 he set off the annelids as a subdivision of the worms, and the radiates as separable from the polyps. Time has confirmed the justice of his division, which depends in every respect upon the organization of the animals. This is the rational method, incorporated in science by Cuvier, Lamarck, and Geoffroy Saint-Hilaire.

As our sketch has so far dealt only with Lamarck's achievements in natural history, we pass with a simple mention a few works in which he treated of physics and chemistry; mistakes of a good intention, which attempted to establish truths that rest exclusively on experiment, by reasoning alone, or to resuscitate old theories like that of phlogiston. These efforts did not even receive the honor of a contradiction; they did not deserve it; and they should serve as a warning to all those who would write upon any science without being acquainted with it, and without having had practical experience in it.

The generalizations of Lamarck in geology and meteorology, sciences which at the time he wrote had hardly come into existence, were mistaken in another sense. They were premature. Every science must begin with the knowledge of facts and phenomena. When these are numerous enough, a partial generalization is possible; as they increase, the basis grows broader; but systems which can justly claim to be absolute and definitive can never be, for they presuppose that all the phenomena and facts are known, a condition which will be impossible as long as man lives. In the beginning of this century geology did not exist, and little was known of the matters of which it treats; but systems were created that included the whole earth. Lamarck elaborated his system in 1802; and twenty-three years afterward the clear mind of Cuvier succumbed to the prevailing tendency, and he published his treatise on the revolutions of the globe. It was Lamarck's merit that he perceived that there were no revolutions in geology, and that the slow manifestations of force through hundreds of thousands of years far better explained the wonderful changes of which our planet has been the scene than violent disturbance could do. "To nature," he said, "time is nothing: it is no obstacle. Nature

always has time enough at its disposal; time is a means of unlimited capacity, through which it produces the greatest as well as the smallest effects."

He was the first who distinguished the littoral fossils from the deep-sea fossils. Yet no one will to-day accept his idea that the sea, by force of its ebb and flow, could have hollowed out its bed and changed its local position on the surface of the earth without altering the relative level of the different points on the surface. In view of recognized facts, it is impossible to ascribe the origin of all the valleys to the wear of the waters. Just as Lamarck's conclusions in the science of organic beings, which he knew so well, were sharp-sighted and prophetic, so were they, in the sciences which were strange to him, careless, hazardous, and destined to be contradicted in the future. Like the metaphysicians, he built in the air, and his structure, like theirs, fell for want of a firm foundation. Limited by his lectures in the Museum, and by the duty of classifying the collections to a definite scientific work, he devoted himself entirely to this double object. In 1802 he published his "Considérations sur l'organisation des corps vivants" (Considerations on the Organization of Living Bodies); in 1809, his "Philosophie Zoologique" ("Zoölogical Philosophy"), an expansion of the "Considérations," and from 1816 to 1822 the "Histoire naturelle des animaux sans vertèbres" ("Natural History of the Invertebrate Animals"), in seven volumes. This was his principal work, and, as it was exclusively descriptive and systematic, it was received by the learned world with great favor. His paper on the fossil mollusks of the neighborhood of Paris, in which his profound knowledge of living mollusks permitted him to make an accurate classification of those remains of animals that had laid for thousands of years in the bosom of the earth, was likewise well received.

Lamarck had begun his zoölogical work when fifty years old. The painstaking study of minute animals, visible only through the lens and the microscope, wore upon his eyesight, which grew feebler and feebler till he became totally blind. Four times married, the father of seven children, he saw his little inheritance, and also his earlier savings, disappear in one of those high-sounding speculations with which a credulous public is often deluded. His modest salary as a professor only kept him from want. The friends of science, whom his fame as a zoölogist attracted to him, were shocked when they observed in what neglect he lived. He spent the last years of his life in total darkness, but comforted by the loving care of his two daughters. The elder daughter wrote at his dictation a part of the sixth, and some of the seventh, volume of his "History of the Invertebrates." After the father could not leave his room, the daughter would not go out of the house; and, when she did at last go out, she could not endure the open air from which she had been excluded so long. Lamarck died on the 18th of December, 1829, at the age of eighty-five years.

It has been more the fashion to condemn Lamarck for his speculations than to give him the credit that is his due for his great work in classification. Recently, however, two naturalists have endeavored to present these speculations in a more favorable light, and, without denying that they embodied much that was not well enough established, to show that much in them was only anticipatory of what science has since accepted: Herr Haeckel, in Germany, who declares that in Darwin, Goethe, and Lamarck, "each of the three great civilized nations of middle Europe has presented mankind in the course of a hundred years with an intellectual hero of the first rank, who comprehended in its full significance the fundamental idea of the concordant development of the world from natural causes"; and M. Barthélemy, in France, who considers that Lamarck was a forerunner of Darwin, and a greater than he.

M. Barthélemy, while admitting that Lamarck's theories on physics, chemistry, and meteorology were frequently rash and lacking the precision that experiment gives, says: "He believed in natural laws, in the unity and transformation of physical and physiological forces, because he attributed a special signification to *nature*. To him nature was a power subordinate to God, its sublime author, who must not be confounded with it, and whose function it is to put to work forces and laws which it has not made, and can not modify. His cosmical system is summarized in the three elements: God, nature, and the universe. Transformism, with Lamarck, is not born of abstract meditations and *a priori* conceptions, as has sometimes been said. It is connected with the whole of the theories that precede. He rose from the careful study of the immense multitude of beings he had to examine to carry order and light into the chaos of invertebrate animals. In his first lectures he began with the most rudimentary beings, the origin of which he attributed to physico-chemical forces, and then saw the organization and the circulation of the fluids become more complicated and more perfect as the scale of being rose with new faculties resulting from the acquisition of new organs derived from the cellular tissue, and owing their origin to new wants or new circumstances in which the being found itself placed. He conceived very clearly the influence of external conditions, and attributed the modifications of organisms to two factors, one interior and constant and regular in its operation; the other exterior and irregular, and including modifications of media, temperature, nutrition, etc. He concluded from this that a continuous chain of beings is not possible, for, if such a chain existed, it would quickly be broken by the accidental or irregular circumstances to which beings are obliged to adapt themselves."

Herr Haeckel pronounces Lamarck's "Philosophie Zoologique," in respect to its uniform and complete deduction of the development theory, as well as to its many-sided empirical basis, far more impor-

tant than the similar efforts of all his contemporaries, even than the similar work of Geoffroy Saint-Hilaire, and styles it "the greatest production of the great literary epoch of the beginning of our century." According to this naturalist's review of Lamarck's system, it supposes that "all the forms of animals and plants which we distinguish as species have only a relatively temporary stability, and the varieties are incipient species. Therefore the form-group or type of the species is just as much an artificial product of our analyzing reason as are the genus, order, class, and other categories of the system. Changes in the conditions of life on one side, the use and non-use of the organs on the other side, constantly exert a formative influence on the organism; through adaptation they bring about a gradual metamorphosis of forms, the principal features of which are transmitted by inheritance from generation to generation. The whole system of animals and plants is thus peculiarly their genealogical tree, and reveals to us the relations of their natural blood-kinship. The course of development on the globe has therefore been continuous and unbroken, like that of the earth itself. . . . Lamarck regarded life as only a very complicated physical phenomenon; for all the phenomena of life depend on mechanical antecedents, which are themselves dependent on the adaptedness of the organic matter. Even the phenomena of the mental life are not different in this respect from the others. For the conceptions and acts of the mind depend upon motor-organs in the central nerve-system." He did not shrink from the solution of the difficult question of the origin of life on the globe, and assumed "that the common primitive forms of all organisms were absolutely simple beings which originated by spontaneous generation, under the combined operation of different physical causes, out of the inorganic matter in water." "Undoubtedly," adds Herr Haeckel, "the greatest defect in Lamarck's work was the insufficient number of observations and experiments which he adduced in proof of his far-reaching theories." A great part of Darwin's immense success was owing to the fact that he was backed by a host of clear and convincing observations and experiments, while "poor Lamarck, trusting too much to the logical acumen of the naturalist, in great part neglected them."

CORRESPONDENCE.

DR. OSWALD AGAIN REPLIES TO DR. BLACK.

Messrs. Editors:

DR. J. R. BLACK'S second epistle, published in the October issue of the "Monthly," can hardly have surprised your intelligent readers, and may even have excited their pity. When people like Dr. Black see a way to achieve publicity, they must be pardoned for trying to make the best of their chance, even on the terms accepted by that Paris quack who volunteered to be pilloried, if they would permit him to exhibit himself in a pair of canvas breeches, displaying a printed advertisement of his pills. Besides, the doctor has somewhat modified his original plan. Having undertaken to pose as a martyr of medical orthodoxy, but finding his nasal organ out of plumb to a degree he had not quite bargained for, he now attempts to effect his retreat under a dust-cloud of irrelevant obscurities.

After admitting that dyspepsia in children *can* be explained by the agency of causes distinct from hereditary transmission (which he had denied in his first letter), he now defies me to prove that, by moderate eating and abstinence from virulent drugs, children can escape the disease. Has the plan ever failed where it had a chance of a fair trial, as in hygienic homes, or in Schrodt's "Boarding Kindergartens"? Or does Dr. Black know what his thesis implies? He can not deny—1. That the digestive organs of children are governed by the same pathological laws as those of adults, the difference, if any, being in favor of the children, since every birth is a hygienic regenesis, and since diseases, as he himself admitted in his first letter, do not exist *per se* from the moment of birth. 2. That a correct regimen and abstinence from noxious drugs will prevent dyspepsia in adults, and cure even far-gone dyspeptics. Yet he holds that a correct regimen and abstinence from noxious drugs will not prevent dyspepsia in children. In other words, the laws of health hold good in the ordinary affairs of life, but may be set aside when it comes to account for the mortality in the infant-wards of an Ohio drug-hospital. Dr. Black informs us that the public is deeply interested in the issue of our controversy. Feverishly. But your readers can make their minds easy. Nature is not so inconsistent as Dr. Black; and I will undertake to insure any child against dyspepsia, nay, any cured dyspeptic against a relapse of the disease, on the sole condition that they shall avoid dietetic abuses and Dr. Black's prescriptions. In his distress to evade the logical inference of his admissions, Dr. Black suggests that some of my arguments might be used to disprove the hereditary tendency of insanity and consumption. Before the doctor's friends permit him to undertake another pathological controversy, I would advise them to enlighten his mind on the difference between functional and organic disorders, and thus enable him to understand the reason why consumption or cancer, but not dyspepsia, can be called an hereditary disease, and why hereditary diseases and not dyspepsia reappear in successive generations at the same period of life when they were first contracted. If I had ever doubted the chronic persistence of mental derangements, I confess that Dr. Black's arguments would have convinced me of my error. The manner of his attempt to defend the drivel of his first letter is a sufficient proof that the taint of idiocy is ineradicable.

In trying to explain away the silliness of his soap-water argument, Dr. Black volunteers the confession that Nature protests against the use of soap when the sensitiveness of the cutaneous tissue has been morbidly increased by the influence of a skin-disease. In other words, he admits that a morbid condition increases the danger of using even the mildest chemical depurative. Yet to the morbidly sensitive membrane of the diseased digestive organs he proposes to apply the virulent "intestinal soaps," as he calls his cathartic drugs. The "striking benefit" resulting from the use of patent laxatives is too exclusively confined to the experience of the patentee.

Dr. Black's assertion that I propose to cure syphilis on the let-alone plan is a fiction which can be pardoned only to a nonplused sophist at the brink of a *reductio ad absurdum*. Not only have I never propounded such a theory, but I have repeatedly named syphilis as the representative disorder of the exceptional class of diseases which (for reasons stated on page 729 of "The Popular Science Monthly" for October, 1881, and on page 199 of my work on "Physical Education") have to be cured by an artificial removal of the cause.

As a last attempt to retrieve the reverses of his game, Dr. Black tries to score a point on a lexicographical quibble. In defending my plea for longer pauses between meals, he says, I have spoken of digestion and assimilation as being one and the same thing. The truth is, that I men-

tioned them as synergistic operations. But within the scope of my argument I would have been justified in treating them as identical functions. Does Dr. Black wish to deny that intestinal digestion, in its normal phases, includes an assimilative process? But, as in the case of *dyspepsia infantum*, the doctor's experience is perhaps limited to the action of a drug-convulsed system, in which case the activity of the digestive organs does, indeed, but rarely lead to assimilation.

Dr. Black's exception-plea in favor of the stimulant superstition illustrates only the radical confusion of his pathological theories. For that energy of action which he mistakes for a sign of restored functional vigor demonstrates nothing but the urgency of an expulsive process. The functional activity excited by the influence of a drastic tonic proves only the virulence of the drug, and the system's eagerness to rid itself of a deadly foe. In my treatises on "Dyspepsia and Climatic Fevers" I have exposed the two most specious fallacies of the stimulant-delusion; and there is an end to all inductive reasoning if the analogies of the stimulant-vice and the medicine-habit do not establish my tenet that the *poison-hunger* in all its forms, whether as *mania a potu*, or a hankering after a digestive excitant, is wholly abnormal and mischievous; that its repeated gratification rarely fails to inoculate the system with the seeds of a progressive stimulant-habit; that the dyspeptic's dependence upon Dr. Black's calomel pills is an aggravation of the original disease; and that even the temporary results, effected at such risk, by the use of virulent drugs, can, in nine cases out of ten, be more safely and as directly attained by other means, as by refrigeration in the treatment of malarial fevers, or indirectly by reform of the predisposing habits, as in consumption and various enteric disorders.

In one of his tirades against heretical theories, Dr. Black carries his bravado to the degree of appealing to the testimony of "stubborn facts"—in other words, to the lessons of experience. I would advise my colleague to avoid that arena. Hospital statistics might prove that the homœopathists can challenge our best record and demonstrate by proofs, which should satisfy a depreciator of their sugar-pellets, that they can beat it by total abstinence from the so-called remedies of the drug-shops.

In his first letter Dr. Black proposed to let dyspeptics trust themselves to the guidance of their morbid appetite, and, after I proved that the absurdity of that plan could be demonstrated by the analogies of the alcohol-habit, our entrapped medicine-man tries to slip out by the following hole: The chronic hunger of the dyspeptic, he informs us, is a craving after food, while the unquenchable thirst of the alcohol-drinker is a craving after poison. Does that subvert my tenet that, in regard to the persistency of the appetite, both cravings are wholly abnormal? For, let us remember that the original point at issue was the question about the proper number of daily meals. Now, in pursuance of Dr. Black's plan, his patients would have to eat about forty meals a day; for, in his first letter, he advised dyspeptics to follow the promptings of an appetite which he now admits to be morbid and unappeasable, as caused by a chronic state of semi-starvation. Thus Dr. Black continually shifts his ground, to dodge the inferences of his own premises. But the fact is, that he never expected to maintain his positions. He merely wrestles against time, and accepts his successive overthrows in the secret hope that the shrieks of his afflictions might attract the aid of some brother-sophist. Hence, also, his repeated allusions to a "numerous class of physicians" whose wrath he warns me to deprecate. Like other champions of orthodoxy who find that their logic leaves them in the lurch, he tries to retreat behind the shelter of a numerical majority.

By my outspoken denunciation of the stimulant-superstition, Dr. Black holds that I have offered an insult to that large body of medical men to whom is due the credit of the most important discoveries in hygiene, physiology, surgery, etc. My orthodox contemporary will try in vain to identify the interests of his cause with the progress of those sciences. All their promoters have contributed their share to undermine the foundations of the position which he tries to defend. For the last hundred years the history of medical science has been the history of a continued and increasingly rapid collapse of the *drug-delusion*—a delusion whose defenders have always tarried in the rear of progress, and, after doing their utmost to obstruct the path of reform, have recognized its triumphs only by sharing the fruits of its victories. My invectives were not directed against the thousand earnest seekers after truth, not against its great discoverers, the pioneers of the true healing art, not against men like Bichat,* Schrodt,†

* "To what errors have not mankind been led in the employment and denomination of medicines! They created *deobstruents* when the theory of obstruction was in fashion; and *incisives* when that of the thickening of the humors prevailed. Those who saw in diseases only a relaxation or tension of the fibers employed *astringents* and *relaxants*. The same identical remedies have been employed with all these opposite views. . . . Hence the vagueness and uncertainty our science presents at this day. An incoherent assemblage of incoherent opinions, it is, perhaps, of all the physiological sciences, that which best shows the caprices of the human mind. What do I say? For a methodical mind it is not a science at all. It is a shapeless collection of inaccurate ideas; of observations often puerile; of deceptive remedies, and of formulas as fantastically conceived as they are tediously arranged."

† "If we reflect upon the obstinate health of

Magendie,* Bock,† Jules Virey,‡ Jennings,§ Rush,‖ but against bigots like Dr. Black; against medical obscurantists who dread the enlightenment of their victims as vampires dread the dawn of the morning; who oppose independent thinkers with that rancorous hatred which Jesuits feel toward the divulgers of their trade-secrets; who, by holding on to the last planks of their wrecked dogmas, by illogical compromises and temporizing sophisms, are trying to perpetuate the curse of a life-blighting delusion; who subordinate the interests of mankind to the interests of their clique, and disparage reformers till they find it convenient to appropriate the credit of their discoveries.

"Some acute philosophers," our obliging correspondent informs us, "think that all the phenomena of the universe can be explained on the laws of mechanics, from the motions of a molecule up to those of the celestial masses." Just so. And Dr. Black might as well confess the secret of his predilection for that system. Its application to therapeutics has so simplified the practice of medicine; and its recognition as the law of the universe would confirm the prestige of the orthodox cause. Instead of troubling himself with a life-long study of the laws and revelations of Nature, the lessons of instinct, the interaction of the vital functions, their modifications under abnormal circumstances, the secrets of the reproductive and self-regulating principle of the human organism, our mechanical philosopher would prefer to re-establish the system of the good old times, when he could consult a pocket-index of drugs, set against an alphabetical list of diseases, point to his diploma as a presumptive proof that he had learned to repeat the Latin synonyms and construct the pharmaceutic symbols of the various "remedial agents," etc., and magisterially reprimand hygienic "idealists," as a village schoolmaster, well read in Genesis, would reprove an exponent of the evolution doctrine.

"Dr. Oswald," says our astute correspondent, "is apparently unable to discern that all the customs and habits of savages are intimately correlated to their vital organism, and that for us to adopt only one of them might prove murderous to civilized beings." Because we can not imitate *all* the customs of a primitive nation, is that a reason why we should not adopt *some* of them? With such arguments our medical censor dares to insult the intelligence of your readers! Must we avoid the unleavened bread of the ancient Hebrews because we dislike circumcision? Must we disparage Japanese temperance, because we do not want to commit *hari-kari*? Would the Samian water-cure prove more murderous to civilized beings than Dr. Black's blue-pills? If I should recommend the system of the medical philosopher Asclepiades, who used to prescribe a special course of gymnastics for every form of human disease, Dr. Black would try to retreat behind his correlation-dodge. "Such systems," he would probably remark, "were intimately correlated to the physical and social organism of the pagan savages and their uncivilized doctors; but nowadays every intelligent druggist would agree with me that it would never do to let people cure their diseases with such reme-

animals and savages, upon the rapidity of their recovery from injuries that defy all the mixtures of materia medica; also upon the fact that the homœopathists cure their patients with milk-sugar and mummery, the prayer-Christians with mummery without milk-sugar, and my followers with a milk-diet without sugar or mummery—the conclusion forces itself upon us that the entire system of therapeutics is founded upon an erroneous view of disease."

* "I hesitate not to declare, no matter how sorely I shall wound our vanity, that so gross is our ignorance of the real nature of the physiological disorders called diseases, that it would perhaps be better to do nothing, and resign the complaint we are called upon to treat to the resources of Nature, than to act, as we are so often compelled to do, without knowing the why and the wherefore of our conduct, and at the obvious risk of hastening the end of the patient."

† "By special methods of diet nearly all known diseases can be cured as well as caused. . . . Twenty-five years' experience at the sick-bed and the dissecting-table, in the nursery and on the battle-field, have convinced me that, with rare exceptions, the disorders of the human body, which have been treated after such an infinite variety of drug-systems, can be as well cured without any drugs at all."

‡ "Our system of therapeutics is so shaky" (*ne cillant*) "that the soundness of the basis itself must be suspected."

§ "It is unnecessary for my present purpose to give a particular account of the results of homœopathy; . . . what I now claim with respect to it is, that a wise and beneficent Providence is using it to expose and break up a deep delusion. In the results of homœopathic practice we have evidence, in amount and of a character sufficient, most incontestably to establish the fact that disease is a restorative operation, or renovating process, and that medicine has deceived us. The evidence is full and complete. It does not merely consist of a few isolated cases, whose recovery might be attributed to fortuitous circumstances, but it is a chain of testimony fortified by every possible circumstance. . . . All kinds and grades of disease have passed under the ordeal and all classes and characters of persons have been concerned in the experiment as patients or witnesses; . . . *while the process of infinitesimally attenuating the drugs used was carried to such a ridiculous extent that no one will, on sober reflection, attribute any portion of the cure to the medicine.* I claim, then, that homœopathy may be regarded as a providential sealing of the fate of old medical views and practices."

‖ "I am here incessantly led to make an apology for the instability of the theories and practice of physic; and those physicians generally become the most eminent who have the soonest emancipated themselves from the tyranny of the schools of physic. Dissections daily convince us of our ignorance of disease, and cause us to blush at our prescriptions. What mischief have we done under the belief of false facts and false theories! We have assisted in multiplying diseases; we have done more, we have increased their mortality. I will not pause to beg pardon of the faculty for acknowledging, in this public manner, the weakness of our profession. I am pursuing Truth, and am indifferent whither I am led, if she only is my leader."

dies. In a country like ours," he would add in a whisper, "the introduction of such a system might prove murderous to some civilized beings."

Dr. Black complains of my superciliousness in preferring a charge of ignorance against a contemporary who has for a long series of years anxiously sought the solution of "the problem how the sick can be made well." Sad enough; but that is no reason why I should withdraw my charge. Dr. Black may have sought that solution for a most venerable series of years, but, unless he holds his own time as cheap as that of your readers, he ought to seek it more anxiously than ever, for it is very evident that he has not yet found it.

FELIX L. OSWALD.

THE GEOLOGICAL DISTRIBUTION OF FORESTS.

Messrs. Editors:

IN discussing "The Geological Distribution of North American Forests," in your August number (pp. 521, 522), Mr. Thomas J. Howell makes the general statement that the loess (or lacustral deposits) of the campestrian province "is devoid of trees," except where cut through by erosion; from which he infers that "the loess is not capable of sustaining forest-growths for any length of time." By way of explanation, he adds that the loess "evidently was timbered during the time that part of it was covered by lakes and marshes," but, "when the great rivers cut their beds down to nearly their present level, the timber gradually died out." To generalization, inference, and explanation, exception must alike be taken.

In much of Eastern Iowa, and in Southeastern Minnesota, the loess is confined to an irregular zone, five to fifty miles wide, flanking the deeply eroded valley of the Mississippi on the west, and overlapping the glacial drift which forms the greater part of the surface of both States. The western limit of this zone is exceedingly sinuous; lobes of drift extend for miles within its general area, and narrow, finger-like belts of loess, sometimes separating into isolated outliers, extend still farther upon the drift-plain. Now, this drift-plain is quite timberless; but the loess is naturally wooded to its extreme margin, and its outliers are also generally wooded. The coincidence of forest-growth with loess is indeed so perfect in this region that maps showing the wooded area indicate with almost equal accuracy the loess area. This is a region, too, in which not only the "great rivers," but many of their minor tributaries, have cut their channels through the loess, and far into the subjacent rocks, thus developing the picturesque river-bluffs which lure so many tourists to the upper Mississippi region. A parallel relation between loess and forests obtains in Central and Southern Illinois. Here the loess first appears, in passing from north to south, as isolated mounds rising from the almost dead-level drift-plain; which mounds, however far from other forests, are well wooded. The Missouri River loess-belt is, it is true, generally treeless, except along water-ways, which may or may not, however, cut through its deposits; but natural timber is far more abundant than over contiguous drift-areas, while its capability of supporting arborescent vegetation is emphatically attested by the unprecedented growth of artificially-planted fruit and forest trees, which is at once the marvel of Eastern and the boast of Western horticulturists. The potent influence of geological structure in determining the flora of any region is demonstrated by these relations of loess and forests, especially in Northeastern Iowa; but the connection is directly opposite from that which Mr. Howell seeks to establish.

But other and equally significant relations exist. Thus, it has been repeatedly pointed out by the director of the Iowa Weather Service, Dr. Gustavus Hinrichs, that the lines of equal timber in Eastern Iowa correspond remarkably, though in a general way, with the lines of equal rainfall.

Again, the origin of the loess is yet a mooted point in geology, and the declaration that its surface was once marshy is scarcely warranted; while no unequivocal evidence that it was ever more heavily or continuously wooded than now has ever been adduced.

The question as to the distribution of forests, particularly in the campestrian province, is inextricably involved with that of the treelessness of the prairies, concerning which so much has been written, but concerning which it is evident (since neither of the relations pointed out in this note have ever been adequately considered by those who have addressed themselves to the problem) that the last word has not yet been spoken. Mr. Howell would sever the Gordian knot at a stroke; but certainly some of its strands have escaped his blade.

Yours, W. J. MCGEE.

WASHINGTON, D. C., *July* 24, 1888.

INFANTILE DYSPEPSIA.

Messrs. Editors:

REFERRING to the very interesting passage at arms between Dr. Oswald, representing the natural, and Dr. Black, the anti-natural school of medicine, while not desiring to provoke further controversy, I beg leave to offer a few remarks upon one point at issue, viz., that pertaining to the alimentation of infants. Dr. Black (see October

"Popular Science"), while granting the soundness of Dr. Oswald's position as to the "millions of infants who from the moment of birth are overfed and drug-poisoned," viz., that we have here a sufficient cause of dyspepsia, asks: "Well, what of the millions that are not? Are they the ones who do not show any such tendency, despite the fact that some of their progenitors do?" Would Dr. Black have us believe that, outside of "baby-farms," a single babe, of all the millions who live to be born, escapes being constantly overfed and (in consequence) occasionally medicated? I assert that, as to the first count in the indictment, an infant is about as sure to be excessively fed as he is to be born. The only exception in general practice is where the babe is nourished at the breast, and the supply happens to be short of an excess, and even in these cases all haste is made to supplement his natural aliment with the bottle; for mothers are unhappy unless their babies are growing obese at the rate of a pound or more a week. Infants usually measure more round the body, arms, and legs, and weigh more, at some period during their first year—often at six months—than at the age of two and a half or three years. No growing thing, in either the animal or vegetable kingdom, can, under natural conditions, exhibit anything of this sort. Parents, no more than the average "druggist," are aware of the fact that the normal or true growth of an infant is never more than three to five ounces per week, and that all the gain above this is from fat, representing excess, though seldom all of the excess—more or less being daily purged away by the bowels, or excreted through other outlets. All this produces or constitutes disease, leads on to sickness, and probably dosing. While we have to admit that only about forty or fifty per cent are, before the age of five years, stamped out by this combination—a method of getting rid of the weakling* far more cruel than the Spartan plan, of freezing them, or the African, of feeding to the crocodiles—ninety-nine in every hundred are made sick by overfeeding, and few of these escape being more or less drugged. Having made the question of infant dietetics a specialty for the past ten years, I find that to hold to cow's milk as the exclusive diet of bottle-babes (a portion of the cream to be removed in case the milk is very rich in this constituent), limiting the number of meals to three, and somewhat restricting the amount at each meal, and allowing nurslings three to five meals (according as the breast may or may not require the "stimulation" of frequent drawing), is an almost absolute guarantee against the gastro-intestinal disorders which are popularly supposed to be unavoidable at this period of life.

Considerable restriction is essential with bottle-babies; for a greedy infant will at any age swallow at two "sittings" a full physiological ration for twenty-four hours, and, if there is to be no restriction as to the quantity taken at each meal, no more than two should be offered. Furthermore, every infant who is not fed *ad nauseam* will be "greedy." In case of infants nourished at the breast, the flow, if excessive, must be diminished by regulating the mother's diet; for in such cases the excess is due to an over-stimulating or slop diet, which affects the nursing-woman as a "driving" diet does our dairy cows, causing a large yield of unnaturally constituted, though perhaps "rich" milk. In order to show the wide contrast between the universal cramming and a truly wholesome diet, I will cite the case of my own infant, now a "stout, strapping boy" of twelve months, who is one of a number known to me as having enjoyed a really fair chance for proving their fitness to survive. His allowance at this time is a coffee-cupful, or about eighteen tablespoonfuls, at each meal. It is usual for infants to swallow as much, often more than three such cupfuls, every day, at the age of three or four months, except when nausea or lack of appetite prevents. They are either "constantly" fed, or at least have a meal every two or three hours. This is the practice with the "million," by which I presume Dr. Oswald meant all "civilized" infants, including Dr. Black's, if he has been blessed with such "troublesome comforts," as they are universally called—a term, by-the-way, in itself very significant in this connection; for, again referring to the few infants who have been exceptionally fed, "breathed," clad, and exercised, i. e.—1. Fed in the manner I have described as constituting a physiological diet; 2. Given the breath of life, viz., outdoor air twenty-four hours a day, whether the babe is in-doors or out; 3. Saved from sweltering clothing—allowing the skin to "breathe"; 4. Rationally "neglected," or, in other words, instead of being constantly held, tended, or wheeled, early allowed the opportunity, on the floor or lawn, of rolling, tumbling, stretching out, and learning to creep at an early age, thus earning a good digestion, and avoiding one of the principal causes of infantile dyspepsia, by being, like kittens, puppies, and young monkeys, largely "self-supporting," and like them developing naturally in all parts of the frame—by these means, I would say, it has been shown to be entirely practicable to insure for the "infant race" a condition as comfortable,

* Quoth Dr. Black, "Now, we nurse them (the weaklings) to adult life!" In fact, only about fifty to sixty per cent of all infants arrive at adult age, and these have been fitly described as "too tough to kill." Even these, to the last one, would make healthier men and women, if saved the abuses we have named.

happy, and thrifty, as that enjoyed by the most fortunate of the nurslings of our domestic animals or household pets.

If in order, I would also venture to cite a case of gastric cramps similar to that mentioned by Dr. Black, but more "naturally" cured. I was called one day during the past summer to the bedside of an old lady friend, who is sixty-six years of age, and very frail. She was suffering intensely from acute dyspepsia. "Well, doctor," she moaned, between the spasms, "you—will have—to—give—me—some—medicine this time!" "Very good," I replied, "here it is." (Having obtained a hint from the nurse as to the state of affairs, I had ordered up a pitcher each of hot and cold water.) "Just drink this cupful of warm water. Take it right down, please, as if it were a delicious draught, and you were feeling very thirsty." This she did, and then another and another, and so on until she had, within twenty minutes, taken eight full cups. Then I asked her to make a slight exploration to see if she could touch that warm water with her forefinger! She made the attempt and succeeded—the water meeting her more than half-way. Along with the water came the cause of the cramps, in the shape of undigested food. Directly after this she swallowed, though under protest, seven cupfuls more of the same safe remedy, which had just the effect I anticipated. She soon became entirely at ease, rested quietly for the balance of the afternoon, slept soundly that night, and awoke next morning to laugh over the experience of the day before. There was no poison taken to tax the organism. The water did its perfect work—washing the stomach, diluting the blood, and aiding in the elimination of impurities, instead of adding to them in the least degree. C. E. PAGE.

NEW YORK, *September* 17, 1888.

EDITOR'S TABLE.

THE CURRENT STUDY OF CLASSICS A FAILURE.

PRESIDENT PORTER has replied to Mr. Adams on the Greek question. The President of Yale College, we need not say, is a very strong man—an eminent scholar, an experienced educator, a keen controversialist, and thoroughly familiar with this subject; and so in the "Princeton Review" for September, in the opening article, entitled "A College Fetich," he has given what must be virtually accepted as the official answer to Mr. Adams's argument. Assuming, then, that President Porter has made out the best case possible, let us see whether Mr. Adams's main position has been successfully assailed or remains undisturbed.

It will be remembered that in his Phi Beta Kappa address Mr. Adams arraigned the system of classical study in Harvard College, and more emphatically that of Greek, as a failure; and he appealed to his own experience, and to that of three generations of his ancestors, in proof of the charge. He alleged that the time spent upon classical languages was wasted, first, because he did not master them, and, second, because the time spent upon them ought to have been given to more valuable acquisitions in preparation for the duties and responsibilities of modern life.

President Porter takes issue with Mr. Adams on the main points of his argument. He holds to "the perfection of the Greek language as an instrument for the perpetual training of the mind of the later generations"; and maintains that "the ancient languages, in their structure, their thoughts, also in the imagery which their literature embodies, are better fitted than any modern languages can be for the single office of training the intellect, and the feelings, and the taste; and in every one of these advantages the Greek is pre-eminently superior to the Latin." As a consequence, he maintains that "the old classical training" is the best preparation for the intellectual work of modern life, the best corrective of its injurious influences, and therefore not an educational failure.

But Mr. Adams had condemned the system after trial of it. He had diligently pursued the classics as prescribed

and taught in the preparatory schools and at Harvard College, and found that they had yielded to him none of the great and salutary results that are claimed for them. President Porter replies that we are not bound to accept the cause assigned for the alleged failure. He says: "Mr. Adams seems to forget that at least *three* solutions may be given for the apparent failure of his own college life, of which he has recognized but one: 1. The failure was only apparent, but not real, or not to the extent which he imagines. He derived more advantage than he is now aware of, even from the Greek. . . . 2. The curriculum may have been wisely selected, and the teaching may have been imperfect. . . . 3. The student may neglect and render futile the most wisely-selected curriculum, even when enforced by the most skillful and zealous teaching."

It is upon the first of these considerations that President Porter lays the greatest stress in his article. He does not urge the other alternatives—either that the Harvard teaching was bad, or that Mr. Adams was idle or negligent, but he argues that Mr. Adams is mistaken in his assertion that he derived no important benefits from his classical studies. He says: "In judging of the effects of a course of studies, the sharp distinction should be made between the impressions which are actually received, and the reflective recognition of these impressions by the recipient and his own consequent estimate of them." And again: "It is certainly no new thing for children, even those of an older growth, to fail to appreciate the value of the training to which they owe all their success in life, and to esteem those features of it the least to which they owe the most."

We have here the old stock defense of the classical superstition. It is not a failure, because it exerts certain wonderful and mysterious influences of which the student may not be aware, but which are abundantly vindicated by time. That is, the student is not the proper judge of the effects upon his own mind of the leading studies to which he gives the best years of his life. But it is proper to ask, If those who have had experience of it "fail to appreciate the value of the training to which they owe all their success in life," who else has authority to speak in the matter? The argument cuts both ways. If Mr. Adams did not know when he declared that the study of Greek had in his case proved a failure, does President Porter know when he denies it? If the evidence of experience is not to be trusted, what evidence is to be taken? The case looks like one of dogmatic assumption against positive self-knowledge. If a college graduate, after long trial of his education in the arena of practical life, is incompetent to decide upon its adaptability and adequacy to his needs, then there are no valid grounds of judgment in the matter. But the idea is an outrage upon common sense, and we might be well surprised that it should be put forth by a distinguished college president if we did not know to what ridiculous shifts the classicists are driven in defense of their anomalous traditions. Sydney Smith long ago declared, in relation to the classical superstition, that it has been the practice of the universities "to take credit for all the mind they did not succeed in extinguishing." The practice lives on in the equally preposterous assumption that all the success a university man achieves in life is due to the Greek and Latin he learned or did not learn—whether he knows it or not. That this nonsensical notion should be so all-prevalent, and still so influential with multitudes, only shows how completely even our higher education is still in the fetichistic stage.

What President Porter had before him to do was to break the force of Mr. Adams's testimony that his clas-

sical education had proved a failure. He first tried to discredit him as not knowing the difference between failure and success, intimating that Mr. Adams has been after all a very successful man; that he studied Greek; therefore, by a well-known classical formula, his success was due to his Greek. But President Porter is not entirely satisfied with the sufficiency of this logic, and so he proceeds to strengthen his case by resorting to counter-testimony. Suddenly converted to the faith that the evidence of men of experience *is* worth something—at least when it comes on his side—he cites repeated cases of men who, in opposition to Mr. Adams, set a high value on their classical education. The question, then, is, to what extent is Mr. Adams's view substantiated by the testimony of others, and of those who must be regarded as the highest authorities? Let us rule out the enemies of the classics—those ignorant of them or prejudiced against them—and appeal to men whose sympathies and predilections are on the other side, but who have had large opportunities of observing the results of classical study—eminent educators, college presidents, experienced teachers, and professors of Latin and Greek, and those who have systematically and under responsibility inquired into the general working of this kind of education.

A conspicuous example of such testimony is obtained without going very far. The eminent President of Columbia College, Dr. F. A. P. Barnard, is a man of enlarged experience in the field of collegiate education, and he has anticipated Mr. Adams in the emphatic reprobation of dead-language studies, on the ground of their incontestable failure. In an address before the University Convocation a few years ago President Barnard said: "What are in fact the results which we do actually reach in the teaching of the classics at this time? Are they in truth anything like what we claim for them? We hear, for instance, a great deal said of the intellectual treasures locked up in the languages of Greece and Rome, which it is asserted that our system of education throws open to the student freely to enjoy. And yet we know that practically this claim is without foundation. It will not, I presume, be affirmed of the graduates of American colleges generally that they become familiar with any portions of the literature of Rome and Greece which do not form part of their compulsory reading. It will hardly be affirmed that one in ten of them does so. And why not? The reason is twofold: First, there is hardly one in ten in whose mind the classics ever cease to be associated with notions of painful labor. Reading is not therefore pursued beyond the limit of what is required, because it is not agreeable. But, secondly and chiefly, there is hardly one in ten whose knowledge of the Latin or the Greek is ever sufficiently familiar to give him the command of the ancient literature which it is asserted for him that he enjoys. I suppose that, to read with any satisfaction any work in any language, we should be able to give our attention to the *ideas* that it conveys, without being embarrassed or confused by want of familiarity with the machinery by which they are imparted. It will not be for mere pleasure that we shall pursue our task, if every sentence brings us a new necessity to turn over our lexicons, or to reason out a probable meaning by the application of the laws of syntax. And yet, if there be any of our graduates who are able, without such embarrassments, to read a classical author, never attempted before, the number must be very few. If there are any who can read even such books of Latin and Greek as they have read before, with anything like the fluency with which they read their mother-tongue, the number can not be large; and if there are any who can read, with similar facility, classic works which they take up

for the first time, it is so small that I have never seen one. . . .

"Can a person be said to know a language which he can not read? And is it a result worth the time and labor expended upon it to attain such a doubtful acquaintance with a language or anything else, as that which the majority of our graduates carry away with them of these, at the close of their educational career? Might not the same amount of time and labor differently employed have produced at last something having a value at least appreciable? And is not the immense disproportion between labor expended and results obtained itself the best evidence that this labor has not been expended most wisely for the accomplishment of its own avowed end? For surely there can not be any language, dead or living, in the known world, which any intelligent person ought not to be able to acquire, so as at least to read it, in a course of ten years' study."

But it may be said that the American standard of classical attainment is low, and that we must go where the system has been more faithfully tried, for the highest evidence of its advantages. Very well, and it happens that this evidence is abundant. Classical studies have been tested upon the most extensive scale, and under all the most favorable conditions. For hundreds of years they have been the staple elements of English culture. The English universities and the great public schools of England form a consolidated system devoted for centuries almost exclusively to classical teaching. The system has had the authority of tradition, it has been backed by abounding wealth, it has had the patronage of church and state, and has been cherished by institutions of every grade, which have been independent of all disturbance from the caprice of public opinion. If "the perfection of the Greek language," as President Porter assumes, fits it as "an instrument for the perpetual training of the mind of the later generations," then the circumstances of English education have been most favorable for proving it. But what is the result? A thousand authorities may be summed up in the following sentence of a letter from Professor Blackie, of Edinburgh, to the late Dr. Hodgson. He says, "I entirely agree with you that the present system of classical education, as a general method of training English gentlemen, is a superstition, a blunder, and a failure." The evidence is overwhelming that the great mass of students, in the best English institutions, so far from gaining access to the sphere of classical thought, do not even get a decent knowledge of the bare forms of the dead languages themselves. To such an extent had classical study become itself an utter failure, and to such an extent did it stand in the way of all other studies, that it came to be widely denounced as a scandal to the nation, and the Government was called upon to interfere and put an end to it. They are very cautious in England about meddling with old and venerated things by the intervention of law, but they have a salutary habit of inquiring into them with great thoroughness upon suitable occasions. Parliamentary commissions were therefore appointed to investigate the condition of education, both in the universities and in the great public schools which prepare young men for the universities. The reports that resulted were monuments alike of searching inquiry and the total failure of the cherished classical education. The London "Times" thus summed up the report of the commissioners upon the teaching of the public schools: "In one word, we may say that they find it to be a failure—a failure, even if tested by those better specimens, not exceeding one third of the whole, who go up to the universities. Though a very large number of these have literally nothing to show for the results of their school-hours,

from childhood to manhood, but a knowledge of Latin and Greek, with a little English and arithmetic, we have here the strongest testimony that their knowledge of the former is most inaccurate, and their knowledge of the latter contemptible."

And now let us observe how this thorough-going system is characterized by one who has had the best possible opportunities for observing and knowing its results. In a lecture delivered before the Royal Institution of Great Britain, by the Rev. F. W. Farrar, a distinguished author and philologist, and who was one of the masters of Harrow School, and for thirteen years a classical teacher, we have the following estimate of the present value of the system. Canon Farrar says: "I must, then, avow my own deliberate opinion, arrived at in the teeth of the strongest possible bias and prejudice in the opposite direction—arrived at with the fullest possible knowledge of every single argument which may be urged on the other side—I must avow my distinct conviction that our present system of exclusively classical education, as a whole, and carried out as we do carry it out, is a deplorable failure. I say it, knowing that the words are strong words, but not without having considered them well; and I say it because that system has been 'weighed in the balance and found wanting.' It is no epigram, but a simple fact, to say that classical education neglects all the powers of some minds, and some of the powers of all minds. In the case of the few it has a value which, being partial, is unsatisfactory; in the case of the vast multitude it ends in utter and irremediable waste."

In speaking of the defects in teaching the dead languages, President Porter refers to the superiority in some points of English over American methods. He says: "The culture and elevation which might come were the power of rapid and facile reading cultivated, and the use of it, or the expression of thought and feeling appreciated, fail in great measure to be attained. These mistakes and failures are probably more conspicuous in the American colleges than in those of England or Germany, for the reason that in England composition in prose and verse compels to a certain mastery of the vocabulary, and a sense of the use of words which mere grammatical analysis can never impart."

Certainly, if anywhere, we should expect to find in these critical constructive exercises in "composition in prose and verse," which President Porter recognizes as a special excellence of the English teaching, the most successful exemplification of the benefits of classical culture. But Canon Farrar refers to this very practice in the following scathing terms as the worst failure of the system: "To myself, trained in the system for years, and training others in it for years—being one of those who succeeded in it, if that amount of progress which has been thought worthy of high classical honors in two universities may be called success—influenced, therefore, by every conceivable prejudice of authority, experience, and personal vanity in its favor, I can only give my emphatic conclusion that every year the practice of it appears to me increasingly deplorable, and the theory of it every year increasingly absurd."

After giving some examples, this disgusted but but unusually candid classical teacher thus proceeds: "This is the sort of 'kelp and brick-dust' used to polish the cogs of their mental machinery! And when, for a good decade of human life, and those its most invaluable years, a boy has stumbled on this dreadful mill-round, without progressing a single step, and is plucked at his matriculation for Latin prose, we flatter ourselves, forsooth, that we have been giving him the best means for learning Latin quotations, for improving taste (or what passes for such), for ac-

quiring the niceties of Greek and Latin scholarship! We resent the nickname of the 'Chinese of Europe,' yet our education offers the closest possible analogue to that which reigns in the Celestial Empire, and for centuries we have continued, and are continuing, a system to which (so far as I know) no other civilized nation attaches any importance, yet which leaves us to borrow our scholarship second-hand from them; which is now necessary for the very highest classical honors at the University of Cambridge alone; in which only one has a partial glimmering of success, for hundreds and hundreds who inevitably fail; and in which the few exceptional successes are so flagrantly useless that they can only be regarded at the best as a somewhat trivial and fantastic accomplishment—an accomplishment so singularly barren of all results that it has scarcely produced a dozen original poems on which the world sets the most trifling value; while we waste years in thus perniciously fostering idle verbal imitations, and in neglecting the rich fruit of ancient learning for its bitter, useless, and unwholesome husk—while we thus dwarf many a vigorous intellect, and disgust many a manly mind—while a great university, neglecting in large measure the literature and the philosophy of two leading nations, contents itself with being, in the words of one of its greatest sons, 'a bestower of rewards for school-boy merit'—while thousands of despairing boys thus waste their precious hours in 'contracting their own views and deadening their own sensibilities' by a failure in the acquisition of the useless—while we apply this inconceivably irrational process to Greek and Latin, and to no other language ever yet taught under the sun—while we thus accumulate instruction without education, and feel no shame or compunction if at the end of many years we thrust our youth, in all their unwarned ignorance, through the open gate of life—while, I say, such a system as this continues and flourishes, which most practical men have long scorned with an immeasurable contempt, do not let us consider that we have advanced a single step in reforming education, to reform which, in the words of Leibnitz, is to reform society and to reform mankind."

This is sufficiently explicit and emphatic as to the worth of current classical study, but the ever-ready objection is, that all this condemnation is only true of the bad methods by which the dead languages are taught, and that, if they were taught as they should be and can be, there would be no basis for the charge of failure. But Mr. Adams's arraignment was of the existing practice, and he did not deny that there may possibly be a better practice in which classical studies shall be successful. President Porter does not hesitate to fall back upon the bad methods of teaching as giving some excuse for the charge of failure. We suspect, however, that a good deal more is made of this bad-method pretext than it will bear, and that the study of dead languages as a leading element of higher education in this age must remain a failure, whatever the perfection of the methods employed in their acquisition. Indeed, it becomes a serious question whether, broadly considered, perfected methods would not lead to worse failure than the existing practice. But we must postpone this aspect of the discussion to another time.

LITERARY NOTICES.

FRENCH AND GERMAN SOCIALISM IN MODERN TIMES. By RICHARD T. ELY, Ph. D. New York: Harper & Brothers. Pp. 262. Price, 75 cents.

PROFESSOR ELY has here presented in small compass and attractive form a large amount of information about the notable socialistic and communistic schemes that have been brought forward in the two coun-

tries where most of such projects have originated. The distinction between socialism and communism he states as follows: "The central idea of communism is economic equality. It is desired by communists that all ranks and differences in society should disappear, and one man be as good as another, to use the popular phrase. The distinctive idea of socialism is distributive justice. It goes back of the processes of modern life to the fact that he who does not work lives on the labor of others. It aims to distribute economic goods according to the services rendered by the recipients." The earliest leader to receive attention is Babœuf, whose career began about a hundred years ago. He and Cabet, who was born twenty-four years later, are described by the author as "the two leading French representatives of pure communism." Babœuf's plan for the reorganization of society was adapted to produce a cheerless monotony, but that of Cabet is more attractive. Under that of the latter, goods and labor are common property; executives are chosen by ballot; marriage and family are held sacred. Young persons may choose their own career, but overcrowding of any profession is to be prevented by competitive examination. Science and literature are encouraged. Professor Ely describes the system of Count Henry de Saint-Simon as the first example of pure socialism. Saint-Simonism regards the dead level of communism as even more unjust than the present state of things, and aims to proportion each man's share of benefits to the service he renders the world. Religion should be reformed, not abolished, and all men should regard each other as brothers. All privileges of birth, including inheritance, were to be abolished. We find Saint-Simon and Fourier thus compared: "Each was required as a complement of the other. The one started in his career as a man of wealth and social eminence, the other as a man of the people. The one observed society, studied its history, its development, and sought to find therein a clew to guide him in his work of regenerating the world, morally and economically; the other, regarding the past as such a series of blunders as to afford no proper basis for future formations, searched the depths of his own consciousness, and discovered a law which furnished premises enabling him to construct deductively an ideal and perfect society, and to explain with mathematical accuracy the past, present, and future." Recognizing the absurdity of a large part of Fourier's writings, our author maintains that this is no reason for condemning the social scheme which he originated. Chapters are devoted to Louis Blanc, Proudhon, and to "Socialism in France since Proudhon."

German socialism is distinguished by its profundity. "One of its leading characteristics," says our author, "is its thoroughly scientific spirit. Sentimentalism is banished, and a foundation sought in hard, relentless laws, resulting necessarily from the physiological, psychological, and social constitution of man and his physical environment." Rodbertus, one of the earliest and ablest of German socialists, selects as the two chief economic evils, which cause most of the others, pauperism and financial crises. These could only be abolished by securing to laborers "a share in the national product, which increases *pari passu* with increasing production." A clear account is given of social democracy, and of the views of Karl Marx and Lassalle, the most prominent members of the party. A short chapter is devoted to the professorial socialists, among whom Bismarck is numbered; and, lastly, the views of the Christian socialists are presented.

The spirit in which Professor Ely deals with his subject is most commendable. His book is entirely free from the partisan views and the epithets that we find in the writings of so many of those who view socialism from the outside. It will do a great deal to correct the ignorant notion that socialists are a set of vagabonds who are anxious to divide with any one who has more than they, and to distinguish the views that some socialists hold on other subjects from socialism itself.

THE VERTEBRATES OF THE ADIRONDACK REGION. By CLINTON HART MERRIAM, M. D. From the Transactions of the Linnæan Society of New York for 1882. Press of L. S. Foster, New York.

THE Adirondack Mountains have a more than local reputation as the happy hunting-ground of those who find in "roughing it" the panacea for most earthly ills. We have read much of the thrilling times when

painted savages made their echoes ring with wicked cries, and are familiar with the pleasures that peace and later days give to the lover of deep woods. Now Dr. Merriam has taken up the natural history of the wilderness, and is the first to give us the characteristics which distinguish this tract, as a whole, from the surrounding country, and to present with scientific accuracy the peculiarities of its fauna and flora.

The first chapter treats of the location and boundaries of the Adirondacks, geological history, topography, climate, general features, botany, and faunal position, and contains much that is of general interest.

The author says: "From a geological stand-point, the Adirondacks are interesting as constituting one of the few islands that rose above the level of the mighty continental sea previous to Paleozoic time. Its stern Archæan shores were washed by the waves of countless ages before the undermost strata of the lower Silurian were deposited upon them, entombing and preserving many of the trilobites, brachiopods, and other curious inhabitants of that vast ocean. This lower Silurian zone marked the shoreline, so to speak, of the ancient island, and consists of Potsdam sandstone and the limerocks of the Trenton period. Though broken and interrupted, enough of it still remains to afford us tantalizing glimpses of the life of the time, torn pages of fragmentary chapters that constitute but a half-told story to excite our imagination and regret."

As to the forms of the mountains, they are in no sense a chain, but consist of more or less irregular groups, isolated peaks, and short ranges, having no regular trend, conforming to no definite axis, and sloping in all possible directions.

The entire region is studded with hundreds of beautiful lakes of various sizes and depths, two of them upward of four thousand feet above tide-level. Under the head of "Climate" the writer speaks at some length of the meteorology of the region, and states that the mean annual rainfall exceeds that of most portions of the State by about five inches. After dwelling upon the causes which serve to lower the temperature, increase the humidity, and promote great luxuriance of vegetation, he recounts the singular fact that many characteristic marsh-plants grow upon the highest summits, as the conditions previously described tend to produce upon them the effect of marshes. On the very top of Mount Marcy a number of these swamp-plants have been found; a matter of especial interest, as there are no trees to protect them from the sun, and they grow on the open summit nearly five thousand feet above tide-level.

In "Botany' he enumerates thirty-two species of forest-trees, fifty-seven of undershrubs, and one hundred and seventy-eight of the most noticeable flowering-plants. As to the "Faunal Position," he is of the opinion that the temperature alone would show that the district belongs to the Canadian fauna, and a number of the resident birds and mammals are cited in support of this view.

The other five chapters are given to Mammalia, Aves, Reptilia, Batrachia, and Pisces, respectively. Of the "Mammalia" forty-two species are enumerated, but the first part ends with the consideration of the carnivora, and constitutes a most important original contribution to the literature of North American mammals. We have grown accustomed to the modern iconoclast haunting all paths of learning, and now it is Dr. Merriam who robs us of our time-honored panther, the bloodthirsty monster of the deep woods. Not that he takes him entirely away, but he only lets him do some fearful leaping to satisfy our old ideal. He says the panther is an arrant coward; that he is not fierce unless he is wounded, and cornered at that; he does not climb trees except at the point of the bayonet, as it were, and he does not scream screams that curdle the blood; at least, it is the testimony of the most reliable hunters that he rarely makes any noise at all. But he does eat porcupines until his mouth bristles with quills, and he does catch deer, even if he has to make quite a jump to do it.

Lack of space obliges us to refer the reader to the book itself for a further knowledge of its contents, which will abundantly repay perusal, and will confirm what indeed is apparent throughout the work, that the author is thoroughly acquainted with his subject, and writes about it in a style which is at once entertaining and instructive.

VAN NOSTRAND'S SCIENCE SERIES, No. 66, DYNAMO-ELECTRIC MACHINERY. A series of Lectures by SYLVANUS P. THOMPSON, Professor of Experimental Physics in University College, Bristol. New York: D. Van Nostrand. Pp. 218. Price, 50 cents.

THIS latest addition to the Science Series deals with a variety of machine which has so rapidly attained prominence that few persons have yet been able to gain an adequate idea of its forms or principles. In the first of these lectures, on "The Dynamo in Theory," Professor Thompson proposed a division of dynamos into three classes, according to the movement of their armatures in the field of electrical force. He then took up the conditions on which the amount of force generated depends, and showed how far the fulfillment of each is compatible with fulfillment of the others. In respect to the condition of size, he calculates that, if the size of a machine is increased n times in linear dimensions, the efficiency will be increased n^5 times. Under "The Dynamo in Practice" he has described the arrangement of the several elements as they appear in the machines of a large number of prominent electricians. The third lecture sets forth the principles on which is based the employment of the dynamo in converting the energy of electric currents into the energy of mechanical motion, and contains a demonstration of the mathematical law of efficiency of the dynamo as a motor. The volume is well supplied with illustrations.

LOCAL GOVERNMENT IN ILLINOIS. By ALBERT SHAW, A. B.; and LOCAL GOVERNMENT IN PENNSYLVANIA. By E. R. L. GOULD, A. B. Pp. 37. Price, 30 cents. LOCAL GOVERNMENT IN MICHIGAN AND THE NORTHWEST. By EDWARD W. BEMIS, A. B. Pp. 25. Price, 25 cents. Baltimore: Johns Hopkins University.

THESE pamphlets belong to the series of "Johns Hopkins University Studies in Historical and Political Science," and speak well for the practical value of the plan on which the studies are based. The paper on Illinois shows how the southern counties of that State, being settled from the South, were organized on the Virginia plan, in which the county is the chief factor and the township is insignificant; while the northern counties, settled later from New England, were organized on the New England plan, with the township as the principal factor. The two systems have met and struggled for the mastery; the New England plan is prevailing, and now only about one fifth of the one hundred and two counties in the State cling to the old county system. The history of the development of the Pennsylvania system is more complicated. As it stands, it occupies the middle ground between the New England township and the Southern county systems, and aims at a partition of power, for the terms of which we must refer to the pamphlet. The organization in Michigan is a transplantation of the New England system, with unimportant differences. In Mr. Bemis's paper, the Michigan system is compared with that of each of the older Eastern States and with the systems which have been or are being adopted in the other States of the West and Northwest, including the newer Territories; and the gradual introduction and growth of the township system in the Southern States is noticed.

THE SCIENCES AMONG THE JEWS BEFORE AND DURING THE MIDDLE AGES. By M. J. SCHLEIDEN, Ph. D. Baltimore: D. Binswanger & Co. Pp. 64.

FOUR editions of this essay have been published in Germany, but this is the first time it has been given in an English dress. It presents, in a rapid view, the record of what the Jews achieved for the advancement of mankind during the period indicated in the title, by their labors in literature, philosophy, science, and art. Their schools in Europe were, it is claimed, among the best of the period, and were attended even by the Christian clergy, because they furnished almost the only means of mental culture. Having no doctrinal theology, they were able to pursue every branch of study untrammeled, and their literature is rich in the fruits of their many-sided work, particularly in philosophy, ethics, mathematics, astronomy, and hygiene. Down to the thirteenth century, they "far surpassed their Christian contemporaries, as well in point of intellect as in all the sciences having an important bearing on life." They contributed much to the revival of learning in the West, for they understood the languages in

which the ancient learning was embraced, and, "had it not been for the efforts of Jewish translators, it is quite likely that the darkness of the middle ages would have enveloped us a good while longer." They were also active in the arts and trades, and carried on commerce. These statements are not bare assertions, but are sustained by abundant citations and references to authorities, which really constitute the bulk of the volume.

LAKE AGASSIZ: A CHAPTER IN GLACIAL GEOLOGY. By WARREN UPHAM. Winona, Minn.: Jones & Kroeger, Printers. Pp. 24.

LAKE AGASSIZ is the name given to a body of water which is supposed to have been formed in the basin of the Red River of the North and of Lake Winnipeg, during the final melting and recession of the ice-sheet. Measured by the shore-line it was 175 miles, in a direct line 142 miles, from north to south. At its greatest height its outlet was about 1,055 feet above the sea, and was then through the valley of the Minnesota River, the flow to the north which the rivers of the valley now take having been restrained at that time by the thickness of the continental ice-sheet. The elucidating of these hypotheses is accompanied by a study in detail of the geological features of the district supposed to have been occupied by the lake.

THE IROQUOIS BOOK OF RITES. Edited by HORATIO HALE, M. A. Philadelphia: D. G. Brinton. Pp. 222. Price, $3.

THIS is the second volume of the "Library of Aboriginal American Literature" of which Dr. Brinton has undertaken the publication. The book itself is an aboriginal composition, partly in the Mohawk and partly in the Onondaga languages, and comprises the speeches, songs, and other ceremonies which composed the proceedings of the council when a deceased chief was lamented and his successor was installed in office. The ritual, which had been preserved by tradition for a period of unknown duration, was reduced to writing at about the middle of the last century, when many of the members of the tribes having learned to write in the orthography devised by the missionaries, the chiefs of the great council directed its composition in that form for permanent preservation. Copies of one part of the work were obtained by Mr. Hale from John Smoke Johnson, Speaker of the Great Council, and a descendant of Sir William Johnson, and Chief John Buck, Record Keeper; and of the other part, from the interpreter Daniel La Fort, of Onondaga Castle. Besides the ritual-books in their originals and English translations, with glossaries and notes, the volume contains a history of the Iroquois nation and league, an exposition of its policy, an account of the origin and composition of the books, a review of the historical traditions of the nation, and an analysis of the Iroquois language. The book is one of great ethnological value, in the light it casts on the political and social life, as well as the character and capacity, of the people with whom it originated.

"THE HOMŒOPATHIC LEADER." Edited by WALTER WILLIAMS COWL, M. D., and Associates. Monthly: July, 1883. Pp. 78. Price, per year, $4.

THIS is the first number of a new magazine, the intended character of which is indicated by its name. It contains, besides a poetical salutatory, nine contributed articles on subjects of disease and treatment, editorial articles, notes, and proceedings of homœopathic societies. The editor reports upon a kind of election he has taken among the practitioners called homœopathic, for the purpose of determining to what extent they adhere to the original principles of the school, in which they have been accused of indulging a growing laxity. So far as the "returns" have come in, the majority still appear to "continue to believe in infinitesimals and dynamization, they still believe in the law of similars, and continue to honor the man who declared the fact and proved its truth."

A PRACTICAL ARITHMETIC. By G. A. WENTWORTH, A. M., and Rev. THOMAS HILL, D. D., LL. D. Boston: Ginn, Heath & Co. Pp. 351. Price, $1.10.

THERE is much that is new in this book as compared with the arithmetics of ten years ago, notably in the arrangement. After five pages on "Numbers," "Decimal Fractions" are at once introduced, and are explained by means of the divisions of United States

money, no separate chapter being given to this latter topic. Then follow the Four Rules, and after them "Metric Measures." The next chapter is on "Common Fractions," and "Measures in Common Use" come next, *after* the pupils have learned the metric system, an arrangement which can not fail to impress upon the young that the English measures are as absurdly inferior to the decimal system as British money is more inconvenient than American. The examples are not of the old-fashioned imaginary kind, but "are intended to convey, incidentally, a great deal of accurate and valuable information; so that, by means of the index, the book becomes a book of reference for many physical and mathematical constants."

THE YELLOWSTONE NATIONAL PARK. A Manual for Tourists. By HENRY J. WINSER. New York: G. P. Putnam's Sons. Pp. 96. Illustrated, with Maps. Price, 40 cents.

A CONVENIENT and acceptable description of the great national Yellowstone reservation, with its mammoth hot springs, the great geyser basins, the cataracts, the cañons, and other features of this land of wonders. The park is about 2,500 miles from New York by way of the Northern, and 3,000 miles by the Union Pacific Railroad. The Northern Pacific road carries, or will shortly carry, passengers directly to the park by its Yellowstone Park branch, while the Union Pacific will deliver them by 110 miles of staging from Beaver Cañon. The fare to the park and back is from $155 to $165.

HOW CAN WE ESCAPE INSANITY? By CHARLES W. PAGE, M. D. Hartford, Conn.: Case, Lockwood & Co. Pp. 22.

THE author believes that hereditary bias must be taken account of, "although it has become too popular as an excuse for results which, through ignorance or design, are often obscure," but that insanity is largely promoted by intemperance, overwork, over-study, and many over-stimulating influences of American life. The escape from it must be prepared for by proper marriages, the cultivation of temperance in all things, and by counteracting the deteriorating influences that affect us.

CHEMISTRY, INORGANIC AND ORGANIC. With Experiments. By CHARLES LOUDON BLOXAM, Professor of Chemistry in King's College, London. Fifth edition. Philadelphia: P. Blakiston, Son & Co. Pp. 640. Price, $4.

BLOXAM'S "Chemistry" is a comprehensive text-book, intended "to give a clear and simple description of the elements and their principal compounds, and of the chemical principles involved in some of the most important branches of manufacture." The book is adapted to beginners, and the more special parts, that the general student would wish to omit, are put in small type. The promise in regard to technological subjects is well kept in treating of the extraction of the several useful metals, of glass, pottery, building materials, explosives, fuel, organic dyes, sugars, animal chemistry, etc. The volume contains a large number of cuts illustrative of the experiments introduced, and of the commercial processes described, and its table of contents is made very full, so as to afford the student a means of self-examination. This new edition "has been carefully revised, and some alterations have been made in the theoretical portion, to bring it into harmony with modern views." The volume is about equally divided between organic and inorganic chemistry.

MANUAL OF TAXIDERMY. A Complete Guide in collecting and preserving Birds and Mammals. By C. J. MAYNARD. Illustrated. Boston: S. E. Cassino & Co. Pp. 101. Price, $1.25.

THIS little book consists of directions for collecting, skinning, and mounting birds and mammals, so that they may be not only ornamental objects, but also useful for the study of natural history. The last chapter is on "Mounting Reptiles, Batrachians, and Fishes."

REVISTA DE AGRICULTURA (Review of Agriculture), NICOMEDES P. DE ADAN, Director. August, 1883. Havana: La Propaganda Literaria. Pp. 32.

THE "Review" is the monthly organ of a circle of land-owners of Cuba, and aims at the development and improvement of the agricultural resources of the island. The contents relate predominantly to the cultivation of sugar-cane and the manufacture of sugar. An article is also published on the cultivation of the eucalyptus.

BRAIN-REST. By J. LEONARD CORNING, M. D. New York: G. P. Putnam's Sons. Pp. 103. Price, $1.

DR. CORNING'S treatment of this important subject consists first of an examination of the nature and phenomena of sleep, and of the relation of the blood-supply to the activity of the brain. Then follow some practical directions in regard to sleeping, and a discussion of the nature of several varieties of insomnia. Finally, some methods of diminishing the cerebral circulation are described, one of them being the "carotid truss," an invention of the author's for lessening the supply of blood through the carotid arteries.

ON THE CONSERVATION OF SOLAR ENERGY. By C. WILLIAM SIEMENS, F. R. S., D. C. L., etc. With Illustrations. London: Macmillan & Co. Pp. 111. Price, $1.75.

THIS volume contains Dr. Siemens's Royal Society paper on this subject, the substance of which is included in his article entitled "A New Theory of the Sun," published in the "Monthly" for June, 1882. Other papers are, letters by MM. Faye and Hirn, T. Sterry Hunt, C. A. Young, and others, criticising his theory, and Dr. Siemens's replies to the same. There is also a paper "On Electrical Discharges in Vacuum-Tubes, and their Relation to Solar Physics," being an extract from a presidential address by the author before the British Association. The appendix comprises a paper entitled "On the Electric Furnace," by C. William Siemens and A. K. Huntington; one on "Sunlight and Skylight at High Altitudes," by Captain Abney; "Remarks of Professor Langley on Ceptain Abney's Paper"; and "Dissociation of Attenuated Compound Gases," by Professor Liveing.

A NEW THEORY OF THE ORIGIN OF SPECIES. By BENJAMIN G. FERRIS. New York: Fowler & Wells. Pp. 278. Price, $1.50.

THE author first examines Darwin's theory, and endeavors to show that the causes it assigns for the production of new species are insufficient. Some of his arguments are based on the non-production of new types in recent time, and on the great changes that the ape of to-day would have to make to develop into the man of to-day. He next discusses the nature of life, and the difference between human and brute life. A chapter is devoted to the question of the existence of a First Cause, which the author is disposed to answer in the affirmative. Finally, he proposes his new theory, which is, that, as "every living organism within historic times has required a receptacle or matrix for its conception, gradual development, and final birth, . . . if species are reproduced by this ordinary process, then it is fair to conclude that they must have originated not by an 'unusual birth,' but by an *extraordinary generation*"—that is, the first members of each new species were produced from a mother of another species by the influence of a "direct creative influx"—i. e., by a sort of miraculous conception.

THE AMERICAN CITIZEN'S MANUAL. Part II. The Functions of Governments (State and Federal). By WORTHINGTON C. FORD. New York: G. P. Putnam's Sons. Pp. 184. Price, $1.

THE purpose of this series—to make citizens at large acquainted with the theory, functions, and operations of the State and national governments, and with their rights and duties—is admirable, and the conception of the several books is well adapted to further it. The present volume treats of protection to life and property; the functions of the Federal Government in the matters of war, foreign relations, regulation of commerce, naturalization, post-offices and post-roads, Indians, the public lands, and patent and copyright laws; the functions of the State government in reference to corporations, education, charitable institutions, and immigration; and State finances.

DR. B. C. FAUST'S LAWS OF HEALTH. Edited by Dr. S. WOLFFBERG. Translated and improved by HERMAN KOPP. Brooklyn: H. Kopp & Co. Pp. 37. Price, 20 cents.

THIS work is a collection of more than a hundred and fifty admirable maxims tersely expressed, embodying sound hygienic principles and practical instructions for the preservation of health. Its peculiar merit is the conciseness with which the rules are phrased, whereby they are more sharply stamped upon the memory and borne in mind. The translator has arranged the manual with particular adaptation to its use in the fourth-reader grade of schools and for self-instruction.

How to get on in the World, as demonstrated by the Life and Language of William Cobbett: to which is added Cobbett's English Grammar, with Notes. By Robert Waters, Teacher of Language and Literature in the Hoboken (N. J.) Academy. New York: James W. Pratt. Pp. 551. Price, $1.75.

The literary style of Cobbett receives in this book about equal attention with the incidents and achievements of his life. Although he is not often named among the masters of English that students of rhetoric are advised to read, and his grammar has been allowed to go out of print, yet the author is able to quote several good judges who agree with him in a high rating of Cobbett's style. Many extracts from Cobbett's writings are given, partly as specimens of his English, and partly as affording a better picture of the man than description could give. The author has secured for his estimate of the character of Cobbett the presumption of correctness, in that he mentions and condemns Cobbett's faults as unhesitatingly as he praises his virtues. The grammar, which is in the form of letters to a son, occupies about half the volume.

French Forest Ordinance of 1669; with Historical Sketch of Previous Treatment of Forests in France. Compiled and translated by John Croumbie Brown, LL. D. Edinburgh: Oliver & Boyd. Pp. 150.

Dr. Brown was formerly Colonial Botanist at the Cape of Good Hope, and had his attention particularly directed to the subject of forestry by observation of the evils which had been brought upon South Africa by the reckless destruction of its woods. He has since become engaged in a kind of philanthropic work of publishing at his own risk books enforcing the necessity of renewing or preserving forests, and explaining the manner in which these objects are to be accomplished; the proceeds of one book, if there be any, being applied to the getting out of another in the series. The present volume embodies a translation in full of the famous ordinance from which it derives its name—a statute which the author claims has exercised a deeper, more extended, and more prolonged influence on the forest economy of Europe than has any other work known to him. As introductory to it, are given notices of the treatment of forests in France in prehistoric times; of the incursion of the Normans and the changes introduced by them; of the administration of the forests of France in the first half of the seventeenth century, and the abuses and devastation of forests which followed; of the method of exploitation then practiced—*jardinage*, or the system of felling a selected tree here and there, and leaving the others standing; of the method of *tire et aire*—or "cut and come again"; of the method of *compartiments*—or the division of the wood into equivalent instead of equal portions, as in the former system, each of which is to be cut in its order in a regular succession of years; and explanations of some of the old technical terms used in the ordinance.

The Pine Moth of Nantucket (*Retinia Frustrana*). By Samuel H. Scudder. Boston: A. Williams & Co. Pp. 22, with Plate.

The pines on the Island of Nantucket, set out some twenty or thirty years ago, are fast dying in large numbers from some cause hitherto unknown. Mr. Scudder began his investigations as to the cause of the destruction in 1876, and found it at the extreme tips of the living twigs, in the shape of a moth-larva, which is hatched out in the bud and eats its way to the heart, sapping the life of the needles, one by one, as it goes downward. As the insects are numerous and prolific they soon take possession of the tree and eat away its life. The present monograph gives an account of the insect and its life-history, as well as descriptions of its relatives, and suggestions as to the way of contending with it.

A Book about Roses. How to grow and show them. By S. Reynolds Hale. New York: William S. Gottsberger. Pp. 326.

The author has been a successful grower and exhibitor of roses, and essays in this book to tell how he has gained his success. With considerable copiousness of words and numerous digressions, all of which go to make his story lively and pleasant, he gives a great deal of information of practical value on all matters pertaining to the cultivation of good roses.

AUTHORS AND PUBLISHERS. A Manual of Suggestions for Beginners in Literature. New York: G. P. Putnam's Sons. Pp. 96.

THE forcible presentation in this work of the publisher's side of the questions on which publishers and authors are supposed to be liable to controversy or misunderstanding has awakened a lively discussion in the literary journals relative to the merits and faults of the two classes. This is well, for the subject is important, vague ideas prevail about it, and the questions relating to it should be settled, so that all can understand the situation, and be ready to accept it. This matter is, however, only an incident in the general purpose of the book, which is to teach young authors how to compose their books and to make bargains with publishers, so as to secure the greatest advantages to themselves, and at the same time make matters easy for the trade. The work contains a description of publishing methods and arrangements, directions for the preparation of manuscript for the press, explanations of the details of book-manufacturing, instructions for proof-reading, specimens of typography, the text of the United States copyright law, and information concerning international copyrights, and useful general hints for authors. All this is of practical value to those who are bent on authorship, and are determined to disregard the advice given in the book to refrain from it.

RECORD FOR THE SICK-ROOM. Philadelphia: P. Blakiston, Son & Co. Pp. 26. Price, 25 cents each, $2.50 per dozen.

THE book is a set of blank tables, each ruled so as to give a record of the condition of a single patient during twelve hours. Columns are provided to show the condition of the pulse, temperature, respiration, and bowels, the medicines and nourishment given, the baths or lotions administered, the temperature of the room, and general notes on the condition of the patient, at each hour, with space at the foot of the table for the physician's directions and memoranda for the nurse. The second page of the cover is occupied with directions for nurses, lists of poisons and their antidotes, and instructions for emergencies.

CONTRIBUTIONS TO THE HISTORY OF LAKE BONNEVILLE. By G. K. GILBERT. Washington: Government Printing-Office. Pp. 32, with Plates.

THIS monograph is a part of the report of the Director of the United States Geological Survey. The study of which it records the results is one of a series designed to include all the lakes of the Quaternary formation. The geological structure of the Great Salt Lake Valley indicates that it was once the seat of an immense lake, with shores a thousand feet above the level of the present lake, while the mountains around bear the marks of shore-lines at different levels, testifying to a system of oscillations of the waters of this great sheet. Mr. Gilbert's studies were directed to the determination of the period at which this lake existed, and of the order of its oscillations. His conclusions are, that the history of the lake reveals the existence of two periods of maxima of moisture, separated by an interval of extreme dryness; that the time since the Bonneville epoch has been briefer than the epoch, and that the two together are incomparably briefer than such a geologic period as the Tertiary; that the period of volcanic activity in the Great Basin, which covered a large share of Tertiary time, continued through the Quaternary also, and presumably has not yet ended; that such earth-movements as are concerned in the molding of continents had not ceased in Western Utah at the close of the Bonneville epoch, and presumably have not yet ceased; and that the Wahsatch Range has recently increased in height, and presumably is still growing.

LIBRARIES AND READERS. By WILLIAM E. FOSTER. Pp. 136. LIBRARIES AND SCHOOLS. Papers selected by SAMUEL S. GREEN. Pp. 126. New York: F. Leypoldt. Price, 50 cents each.

ONE of the good signs of the times is the increased attention that is given to the management of public libraries and the cultivation of correct reading habits and a taste for profitable reading in the general public. Both these books bear on these objects. The first relates to the direction of the attention of those who visit the libraries to the books that will be most advantageous to them—facts to be learned as to each

reader by ascertaining the bent of his tastes and the nature of the subjects in which he has the most living interest—and to the inducement in him of the habit of systematic and methodical reading. The other book is a selection of papers by different authors, having in part a similar bearing with relation to the children in schools; and, in part, showing how the library, properly used, may be made a most efficient auxiliary to the studies of the school.

HANDSAWS, THEIR USE, CARE, AND ABUSE. How to select, and how to file them. By FRED T. HODGSON. New York: The Industrial Publication Company. Pp. 96. Price, $1.

THIS is a book of practical information on matters relative to the qualities and manipulation of all kinds of handsaws, for the benefit of those persons, whether operative mechanics or amateurs, who use them; and it possesses a value to such to which its price bears a really small proportion. It is well illustrated; and a list of works referred to in the preface shows that a considerable literature on the subject exists in out-of-the-way places.

STUDIES IN LOGIC. By MEMBERS OF THE JOHNS HOPKINS UNIVERSITY. Boston: Little, Brown & Co. Pp. 203. Price, $2.

THE "Studies" are the work of students of the university, with one essay contributed by Professor C. S. Peirce at their request. Two of the papers present new developments of the logical algebra of Boole. Another paper relating to deductive logic develops those rules for the combination of relative numbers of which the general principles of probabilities are special cases. In another essay, Dr. Marquand shows how a counting-machine, or a binary system of numeration, will exhibit De Morgan's eight modes of universal syllogism. A second paper by Dr. Marquand explains the views of the Epicureans, known to us mainly through a fragment of the work of Philodemus. Professor Peirce's paper contains a statement of what appears to him to be the true theory of the inductive process, and the correct maxims for the performance of it. The neophyte who takes up these essays with the view of mastering them will find abundant occupation.

DEEP BREATHING. By SOPHIA MARQUISE A. CICCOLINA. Translated from the German by EDGAR S. WERNER. New York: M. L. Holbrook & Co. Pp. 48.

THE subject is considered as a means of promoting the art of song, and of curing weaknesses and affections of the throat and lungs, especially consumption. The author speaks from experience, having had her voice—a rare one for song—restored after she had lost it, by practice in deep breathing. We are told, in the preface to the present edition, that a class in deep breathing was formed in a certain sanitarium after reading one of the chapters of the book; as a result of a few weeks of practice in which, one young woman invalid increased the size of her chest three inches and greatly improved her health, and all received much benefit.

BOOKS FOR THE YOUNG. A Guide for Parents and Children. Compiled by C. M. HEWINS. New York: F. Leypoldt. Pp. 94.

A CLASSIFIED list of the books most suitable for boys and girls, including both children and youth of from ten to sixteen years of age. The author is librarian of the Hartford Library Association. The list is prefaced by a terse review of children's books in general; a number of suggestions on the right use of books; notices of the best works for children in English and American history; and a "symposium," in which are quoted the expressions of several authors and authorities on the reading best suited for children.

THE MODERN SPHINX, AND SOME OF HER RIDDLES. By M. J. SAVAGE. Boston: George H. Ellis. Pp. 160. Price, $1.

A VOLUME of Sunday-morning sermons, of which the first six, constituting a series, deal particularly with the objects of life, business, and education. In the first sermon, "The Modern Sphinx" is made to propound the question, What is the end of man? The answer given is that, as the earth and heavens glorify God by being, man can glorify God only by being himself. To help him accomplish this perfectly, business, brains, and education should be used and sought, not for themselves only, but as means and aids to help him give himself the

highest development. The other sermons are on "The Newspaper—its Good and its Evil"; "A True Republic"; "Progress and Poverty"; "Religious Transition"; and "The Reign of the Dead."

ON THE RELATIONS OF MICRO-ORGANISMS TO DISEASE. By WILLIAM T. BELFIELD, M. D. Chicago: W. T. Keener. Pp. 131.

THIS volume is composed of the four "Cartwright Lectures" delivered by the author in February last, before the Alumni Association of the College of Physicians and Surgeons of New York. It presents a clear and intelligent discussion of the subject, considering the nature and classification of the micro-organisms, their action on plants and animals, the diseases they occasion, and the methods of studying them, with remarks on the germ theory of disease, accompanied by good illustrations. We have been asked to name some comprehensive work on the bacteria. The present treatise is concise and methodical, and makes full use of the latest investigations.

HANDBOOK OF VERTEBRATE DISSECTION. By H. NEWELL MARTIN, D. Sc., and WILLIAM A. MOALE, M. D. Part II. How to dissect a Bird. New York: Macmillan & Co. Pp. 174. Price, 60 cents.

THE intention of the series of which this book is a member is not to enable the student to determine species, but to give the young morphologist practical directions assisting him to learn for himself what a fish, an amphibian, a reptile, a bird, and a mammal are, when considered from an anatomical point of view and contrasted with one another. In the present volume are given specific and detailed directions for performing the several operations of dissection on a bird, which are made more clear by well-executed illustrations. The work has been composed chiefly by Dr. Moale, under the direction of Professor Martin.

DIE KUPFERLEGIRUNGEN, IHRE DARSTELLUNG UND VERWENDUNG BEI DEN VOLKEM DES ALTERTHUMS. (Copper alloys: their representation and application by the people of antiquity.) By Dr. E. REYER. Vienna. Pp. 16.

THE author, who is Professor of Geology in the University of Vienna, has already published a number of monographs on several of the metals which are the objects of man's mining enterprise and have been applied by him to his use, in which he has compressed much valuable information. In the present work he describes the uses that have been made of the alloys of copper, in sections treating of the geology and discovery of the metal, the characteristics of the alloys, the valuable uses that have been made of them, a summary, by nations, of the kinds of alloys that have been used by different people, and the literature of the subject.

DIE KORPERLICHE EIGENSCHAFTEN DER JAPANER. (The Physical Characteristics of the Japanese.) An Anthropological Study. By Dr. ERWIN BAELZ. First Part. Yokohama: Press of the "Echo du Japan." Pp. 16.

THE author of this study is Professor of Clinical Medicine in the University of Tokio, and the essay is a contribution to the "Transactions" of the German East-Asiatic Society. Authorities differ greatly in their estimates of the stature and other physical peculiarities of the Japanese, and betray great inaccuracy in their statements on the subject. Dr. Baelz has sought to remedy this difficulty by instituting a series of systematic and exact measurements. The paper gives the results he has reached. The present (first) part considers anatomical details. It is to be followed by a second part, treating of physiological peculiarities.

PUBLICATIONS RECEIVED.

Archæological Institute of America. Fourth Annual Report of the Executive Committee Cambridge: John Wilson & Son. 1883. Pp. 56.

The Journal of Physiology. Vol. IV, Nos. 2 and 3. Edited by Michael Foster, M. D., F. R. S. Supplement to Vol. IV, containing List of Titles of Works and Papers of Physiological Interest published in 1882. Baltimore: Johns Hopkins University. August, 1883.

The Sonnets of Shakspere: When, to Whom, and by Whom Written. Pp. 12.

New and Important Discoveries in Physiology. By George H. Russell. Newville, Pa. 1883. Pp. 14. 25 cents.

Observations on the Habits of the American Chameleon. By R. W. Shufeldt. 1883. Pp. 8. Illustrated.

The Relations of Pain to Weather. By Captain R. Catlin, United States Army, with Notes by S. Weir Mitchell, M. D. Philadelphia: Collins, printer. 1883. Pp. 19.

A Synopsis of Copyright Decisions. By W. M. Griswold. Bangor, Me. 1883. Pp. 8.

The Structure and Appearance of a Laramie Dinosaurian, pp. 4, with Plates; and On the Mutual Relations of the Bunotherian Mammalia, pp. 7. By E. D. Cope. 1883.

Notes on the Volcanoes of Northern California, Oregon, and Washington Territory. By Arnold Hague and Joseph P. Iddings. 1883. Pp. 13.

The Heart of Man. An Attempt in Mental Anatomy. By Putnam P. Bishop. Chicago: Shepard & Johnston, printers. 1883. Pp. 96.

A History of the New York State Teachers' Association. By Hyland C. Kirk. New York: E. L. Kellogg & Co. 1883. Pp. 174. Illustrated.

Syllabus of the Instruction in Sanitary Science. By Delos Fall. Albion, Mich. 1883. Pp. 7, 10 cents.

On the Right Use of Books. By William P. Atkinson. Boston: Roberts Brothers. 1879. Pp. 65.

God and the State. By Michael Bakounine. Translated from the French by Benjamin R. Tucker. Boston: Benjamin R. Tucker, publisher. 1883. Pp. 52. 15 cents.

A Dictionary of Music and Musicians. Edited by George Grove, D. C. L. Parts XVII and XVIII. London and New York: Macmillan & Co. 1883. Pp. 239. $1 per Part.

Sewer-Gas and its Alleged Causation of Typhoid Fever, pp. 20; and The Status of Professional Opinion and Popular Sentiment regarding Sewer-Gas and Contaminated Water as Causes of Typhoid Fever, pp. 10. By George Hamilton, M. D. Philadelphia. 1883.

The Influence of Athletic Games upon Greek Art. By Charles Waldstein, Ph. D. London. 1883. Pp. 24.

Studies from the Biological Laboratory of Johns Hopkins University. Edited by H. Newell Martin and W. K. Brooks. Vol. II, No. 4. Baltimore. 1883. Pp. 85, with Plates.

Professional Papers of the Signal Service. No. VIII. The Motions of Fluids and Solids on the Earth's Surface. By Professor William Ferrel, with Notes by Frank Waldo. Pp. 51. No. IX. Geographical Distribution of Rainfall in the United States. By H. C. Dunwoody. Pp. 51, with Maps. No. XI. Meteorological and Physical Observations on the East Coast of British America. By Orray Taft Sherman. Pp. 202. No. XII. Popular Essays on the Movements of the Atmosphere. By Professor William Ferrel. Pp. 59. Washington: Government Printing-Office.

Verbal Pitfalls. By C. W. Bardeen. Syracuse, N. Y.: C. W. Bardeen, publisher. 1883. Pp. 223.

Henry Irving. New York: W. S. Gottsberger. 1883. Pp. 207.

Van Nostrand's Science Series. No. 63. Steam-Heating. By Robert Briggs, C. E. Pp. 108. No. 69. Chemical Problems. By James C. Foye, Ph. D. Pp. 141. New York: D. Van Nostrand. 1883. 50 cents each.

Astronomy. By Simon Newcomb, LL. D., and Edward S. Holden, M. A. New York: Henry Holt & Co. 1883. Pp. 338. $1.40.

A New School-Dictionary of the English Language. Philadelphia: J. B. Lippincott & Co. 1883. Pp. 390. 90 cents.

The Fertilization of Flowers. By Hermann Müller. With a Preface by Charles Darwin. London: Macmillan & Co. 1883. Pp. 669. $5.

Annual Report of the Operations of the United States Life-Saving Service for the Year ending June 30, 1882. Washington: Government Printing-Office. 1883. Pp. 504.

Finland: Its Forests and Forest Management. By John Croumbie Brown, LL. D. Montreal: Dawson Brothers. 1883. Pp. 290.

Annual Report of the Board of Regents of the Smithsonian Institution for the Year 1881. Washington: Government Printing-Office. 1883. Pp. 837.

POPULAR MISCELLANY.

School Examinations.—In an address before the Teachers' Association of Cook County, Illinois, Colonel Francis W. Parker, formerly of Boston, now Principal of the County Normal School, severely condemned the prevalent system of examining in schools. He believed that none were more faithful in their efforts than the teachers of to-day, and none were more anxious to do good than they. He had wondered why progress had not been greater, and had come to the conclusion that the greatest obstacle was the examinations. The standard for the work had a powerful influence on the work itself. He believed that examinations were the greatest curse the schools had, though they might be made the greatest blessing. "What is the true motive of examinations? Real teaching leads to the systematic, all-sided upbuilding of a compact body of knowledge in the mind. In this upbuilding or instruction, every faculty of the mind is brought into action—perception, judgment, classification, reason, imagination, and memory. Examinations, then, should test the condition and progress of the mind in its development. Is the common standard of examinations a test of real teaching? If I am not mistaken, the examinations usually given simply test the pupil's power of memorizing disconnected facts. The surest way to effectually kill all desire to study any subject, say history, when the pupil leaves school, is the memorizing of disconnected facts. A no less sure way of creating an intense desire to read history is to take one interesting subject and read from various books all that is said about it, and then under the guidance of a skillful teacher to put together this information, arranging events in logical order, and finally writing out in good English the whole story. It is very easy for an expert in examinations to judge of the true teaching power of the teacher in such work, by the written papers. If meaningless words have been memorized, if there is a lack of research, investigation, and original thought, the results will be painfully evident.

"Examinations should not be made the test of fitness for promotion. Those who understand children will readily appreciate

the excitement and strain under which they labor, when their fate depends upon the correct answering of ten disconnected questions. It is well known to you that some of the best pupils generally do the poorest work in the confusion that attends such highly-wrought nervous states. How much better, then, it is to take the work of the pupil for the whole year, than the results of one hour, under such adverse conditions! If the teacher really teaches, and faithfully watches the mental growth of her pupils through the work of one or more years, she alone is the best judge of their fitness to do the work of the next grade. The examinations of a superintendent should be to ascertain whether the principals under his charge have the requisite ability and knowledge to organize, teach, and supervise a large school. The examinations of the principal should test the teaching power of his teachers. And, lastly, the teachers should test by examinations the mental growth of their pupils. This is the true economical system of responsibility. First ascertain that superintendent, principal, and teacher can be trusted, and then *trust them*. The testimony of countless good teachers has been uniform, when asked, 'Why don't you do better work? why don't you use the methods learned in normal schools, and educational periodicals, and books?' 'We can not do it. Look at our course of study. In three weeks or months these children will be examined. We have not one moment of time to spend in real teaching.' No wonder that teaching is a trade and not an art! No wonder there is little or no demand for books upon the science and art of teaching!"

The Alps in Roman Times.—The ancient Romans, says Professor H. Nissen, of Strasburg, saw in the Alps a kind of a wall completely shutting them out from the people living beyond them, and so for centuries they hesitated to take possession of the mountain-lands, although their legions had subjected all the country at the base of the Alps to the Rhine, and had made demonstrations toward Germany and England. So great was their dread of those unknown heights that they quietly endured the audacity of the rapacious tribes inhabiting them till about fifteen years B. C. Yet Hannibal had crossed them for the first time in September of 218 B. C. This was considered a deed of such magnitude that its success was ascribed by the southern people to the assistance of the heavenly powers. The darkness that rested over the Alps was first illuminated by the historian Polybius, who visited them and described them from his own observations. Roman power was extended over them by Augustus Cæsar, B. C. 15. Afterward roads were built over them, fourteen at least, the laying out of which shows that they were made after careful studies of the situation by the engineers. The opening of the mountains to travel was followed by a great streaming of adventurers in search of the riches to be found in the regions beyond, and scenes were enacted very much like those which were witnessed a few years ago in California. At one time gold was found in such abundance that the price of the metal was depreciated thirty-four per cent through all Italy. The treasure-hunters carried vines with them and planted them wherever they settled down; and to this, in part, Germany owes its wealth in vineyards. The forests were laid waste, as a matter of course, just as they are now wherever a new settlement is planted, and with similar results. The Romans had no appreciation of the beauty and grandeur of the mountains, so highly admired by modern taste, but expressed only dread of them and abhorrence of their savage aspect, which they considered well represented in the barbarous names their indwellers gave to them. They entertained the wildest ideas of the height of the mountains, which they exaggerated tremendously. Pliny, who was a native of Como, at their very foot, speaks of one of the peaks as being fifty miles high, or sixteen times as high as Mont Blanc.

The Venom of Snakes.—Drs. S. Weir Mitchell and Edward T. Reichert have obtained the venoms from several snakes in the shape of a turbid, yellowish fluid, varying in viscidity, odorless, and having an acid reaction. All the venoms are soluble in water at ordinary temperatures, save for a slight cloudiness which but slowly settles. The poisonous principle of the venom of the moccasin and the rattlesnake appears to reside in two out of three proteids which it

contains, one of which is analogous to peptones and is a putrefacient, while the other is akin to globuline and is a much more fatal poison, probably attacking the respiratory centers and destroying the power of the blood to clot. The third proteid resembles the albumens, and is probably innocent. The poisons of the rattlesnake, copperhead, and moccasin are capable of being destroyed by bromine, iodine, bromohydric acid (thirty-three per cent), sodium hydrate, potassium hydrate, and potassium permanganate.

Antiseptic Qualities of Copper.—A few years ago copper was universally regarded as a deadly poison, and any questioning on the subject would, as M. Gautier observes, have been regarded as absurd. This opinion has been shaken by recent investigations. M. V. Burq claims for copper beneficial properties as a disinfectant and prophylactic. He has observed for thirty years that workmen in copper and players on musical instruments of brass, who were liable daily to absorb notable quantities of pure copper-dusts, enjoyed a remarkable immunity from infectious diseases. This was established in the case of the cholera in 1869 and 1873, during the epidemic which prevailed in Paris in 1876 and 1877, and in the recent visitation of typhoid fever, which was the immediate occasion of M. Burq's making a communication to the French Academy on the subject. M. Burq has been encouraged, by his own experiments and those of other physicians whom he cites, to recommend the administration of salts of copper as a preventive and remedy in cases of infectious disease. M. A. Gautier has recently published a book on "Copper and Lead in Food and Industry," in which he denies that copper is as dangerous a substance as it has been considered to be. Citing the observations of Burq, Galippe, and other authors, he discusses, in substantial agreement with them, the effect which copper has in industry and in general use upon workmen engaged with it, and upon public health. He represents it as a normal constituent in many of our foods. Wheat, barley, rice, beans, coffee, etc., constantly contain of it quantities varying from four to ten milligrammes per kilogramme. Prepared foods—greened pickles, chocolate, etc.—contain much more copper, from ten to two hundred milligrammes per kilogramme; and the author shows that, as a rule, we consume five milligrammes of metallic copper a day without receiving any serious injury from it. These quantities could be increased without much danger, but the taste of the salts of the metal is so disagreeable, and their color so conspicuous, that stronger doses would make the food nauseous and repulsive, so that the danger of one taking a fatal dose of copper is really quite remote. All food becomes uneatable when it contains four grammes per kilogramme of copper salts; even voluntary poisoning by copper is almost impossible. A practical inference from these observations would be, that the care we take to tin our copper cooking-vessels is useless. M. Gautier maintains, that it is even dangerous; for most tin contains lead, a deadly poison even in small doses; and it is this metal, in M. Gautier's opinion, that is guilty of the damage that has been attributed to copper. It meets us everywhere, and always leaves its mark in some damage to our system, slight in the detail, but cumulative in the aggregate. We absorb it with our preserved foods, from glazed papers and oil-cloths, from paint, from enamels and crockery, from tin-ware, and from cosmetics, a little every day, till at last enough of the poison is accumulated in the system to make its strength very plainly felt.

How Raisins are dried.—Malaga raisins are made from two distinct kinds of grapes—the Muscat, which is indigenous; and the Pero-Ximenes, which was imported from Germany two hundred or more years ago. Opinions differ concerning the respective merits of the two varieties. The vines are strongly manured, and are allowed to stretch themselves over the ground and absorb all atmospheric heat. The fruit is not all gathered at one time, but the same piece of ground is gone over three times, so that all the grapes may have the necessary ripeness. The raisins are prepared by washing, by drying by steam, or by simple drying in the sun. To dry the grapes by the washing method, furnaces of feeble draught are made in which wood is used as fuel. A round kettle of three or four hundred quarts' capacity re-

ceives a lye formed from the residue or refuse of the grapes after pressing, which is either that obtained from the present year or some that has been kept from a previous vintage. The raisins, held in wire colanders holding from five to eight pounds each, are plunged in this lye while it is boiling. After the immersion, the workmen examine the skins to see if they are shriveled enough. If not, they immerse the grapes a second time, which is usually the last. The process of immersion is a very delicate one, requiring skillful watching and keen judgment on the part of the workmen. The grapes must not be allowed to burst, nor the skins to crack. The grapes must not get too hot or be too sweet, or the raisins will mold. Raisins dried by this process are considered inferior. To prepare raisins by steam, the grapes, after having been sunned for twenty-four hours, are put on drying-shelves in a room heated by steam to 160° Fahr., and kept there for twenty-four hours, when they are taken to a cooling-room to be gradually cooled till they are ready to be packed. Drying in the sun is preferred to the other processes wherever the sun affords enough heat. Stagings are built of brick or stone, on which the grapes are exposed at such an angle of inclination as to be in the sun throughout the day. A temperature of 145° is thus attained in August. At night, the grapes are covered with canvas or with boards. During the process of drying, those grapes that remain green or are spoiled are carefully removed, and each grape is turned, in order to preserve a uniformity in the darkening of color. Raisins prepared by the scalding process dry in four days, while those dried in the sun take ten days, but the difference of time is largely compensated for by the economy of expenditure. The raisins are not ready for packing immediately after being dried, but have to be kept for several days in the stores on the planks on which they are carried. Those that are spoiled or defective are picked out, especially if they appear broken or bruised, for one drop of moisture from them would probably damage a whole box. The crop of raisins produced in the Malaga district from the vintage of 1880 and 1881 is estimated at between 2,000,000 and 2,050,000 boxes of 22 pounds each.

Centripetal and Centrifugal Movements of the Limbs.—Dr. G. Delaunay controverts the theory of Carl Vogt, that the direction of the lines in writing, whether from right to left, the result of a centripetal, or from left to right, the result of a centrifugal, movement of the hand, depends upon exterior conditions rather than a physiological necessity. His investigations have taught him to believe that the general direction of all movements is determined by physiological and anatomical influences. Quadrupeds, he says, as a rule are capable only of vertical or forward and backward movements; a few of them, as the cat and monkeys, can make centripetal movements. Man is the only one who can execute centrifugal ones. The physiological evolution from vertical to lateral—first centripetal, then centrifugal—movements, is a result of an anatomical evolution that has been well described by Broca, in his work on the "Order of Primates." According to M. Delaunay's researches, movements are rather centripetal than centrifugal with primitive or inferior races—rather centrifugal than centripetal with superior races; and the change from one to the other takes place as the race advances. Formerly watches were wound from right to left—now they are wound from left to right. Some English watches are an exception, but the Americans, who are more advanced in evolution (so M. Delaunay says) than the European English, wind their watches from left to right. As it is with watches, so it is with most other machinery. Writing from right to left was characteristic of the earlier nations, and is still so of the less advanced peoples, but has given way to writing from left to right as the races have improved. As between the sexes, women are more inclined to centripetal, men to centrifugal, movements; this is seen in drawing and in the adjustment of clothing. Children are more inclined to centripetal than to centrifugal movements; they strike with their palms rather than with the backs of their hands, draw from right to left, and have a propensity to spell and write in the same direction. M. Delaunay sees in this a tendency to atavism. As between individuals, the more intelligent persons, better scholars, are more ready in left to right, or centrifugal; the less

intelligent, poor scholars, in right to left, or centripetal motions. Idiots can hardly strike with the back of the hand, and are not at ease in lateral movements. In a psychological respect, centripetal gestures denote primitive, egoistic, retrograde ideas, as is seen in the attitude of the miser holding his treasure, and of the coward in the presence of danger. Centrifugal gestures express generous, expansive, altruistic, brave ideas and passions. The gesture of acclamation or applause, for example, is as elevated, as outward, as centrifugal, as possible. "Pleasure," says M. Charles Richet, "corresponds with a movement of blooming, of dilatation, of extension. In grief, on the other hand, we shrink, we withdraw upon ourselves in a general movement of flexion." Thus, in the psychological as well as in other points of view, centripetal gestures mark inferiority, centrifugal ones superiority.

Ancient Love of Honey.—The bodies of Alexander the Great and of the Spartan King Agesipolis were preserved in honey. The ancient Assyrians also used the same substance for embalming. Its preservative effects are, however, only temporary, for, although it prevents the entrance of the germs of decay for a time, it is itself ultimately overtaken by decay, and the bodies it covers must follow it. The ancient use of honey for food was much more important than its application to purposes of embalming. The Greek mythology attributes its origin to Jupiter, who in his youth was fed by goats with milk and by bees with honey. He adopted ambrosia, a compound of milk and honey, to be the food of the gods, and, taking care that the earth should be supplied, caused it to fall as a dew from the sky, and taught the bees to make cells of wax and store honey in them. Aristotle said that honey fell from the air at the rising of the stars and whenever there was a rainbow; Pliny, that it comes out of the air at about daybreak; whence, he adds, "we find the leaves bedewed with honey when the morning twilight appears, and persons in the open air may feel it in their clothes and hair." He also regrets that it can not reach us as pure as it starts, but has to be polluted by the various substances it meets in coming through the air. The northern sagas likewise represent honey as a heavenly product, and relate that it drops upon the earth from the holy ash, and is food to the bees. The ancients used honey as extensively as they did, probably, because they had not learned to extract sugar from the cane. Nearchus says the Macedonians found the sugar-cane in India, referring probably to the bamboo and its sweet juices, and Diodorus and Theophrastus speak of the sweet juice produced by a cane or reed-like plant; but, if cane-sugar was known at all in antiquity, it was known only as a rarity, and honey was still the pre-eminent sweetener. The ancients were well acquainted with the variations in the quality of honey, according to the season when it was stored and the plants whence it was derived. Honey was also used as a medicine for affections of the throat, inflammations of the lungs, and pleurisy, and as an antidote for snake and mushroom poisoning. It was given with mead in apoplexy; mixed with rose-oil it was applied to diseased ears; and it was used to kill vermin in the head. The ancient Germans had a mead or honey wine, which was made by the fermentation of a mixture of honey, water, and herbs, and contained about seventeen per cent of alcohol. Some ancient writers imagined that bees were developed in the decomposing bodies of animals, and an Arcadian shepherd is credited with having discovered the art of cultivating them in this way. Melanchthon believed something of the kind, and saw in it evidence of Providence and a noble symbol of the Christian Church. Honey formed an important article of trade in the middle ages, but gradually declined under the competition of cane-sugar. The destruction of the monasteries at the time of the Reformation caused also a limitation in the use of wax-lights, and a reduction in the demand for comb.

Trees of Lake Chad.—Dr. Nachtigal in his "African Journeys" describes some curious trees that grow in the region of Lake Chad. The butter-tree, called in that country *tôso-kan*, bears a green round fruit, ripening into yellow, about as large as a small citron. This fruit consists of a nut resembling a horse-chestnut in color and

size, and a palatable, fleshy, smooth-skinned covering like a plum. The nut affords an oil, which solidifies under a slight decrease of temperature, and is used throughout North Africa as a substitute for butter. The *Parkia biglobosa* (*runno-kan*) of the same region, a leguminous plant, furnishes an excellent food in its seeds, which are eatable while still unripe. The ripe seeds contain a thick, saffron-colored marrow inclosing black, shining grains. The meal made from them forms when mixed with water or milk a pap, which has a sweet and pleasant taste at first, but soon cloys. Relieved with sour milk or tamarind-juice, it forms a dish healthful and enjoyable to all. The wool-tree (*Eriodendron anfractuosum*) is the third characteristic tree of the country. It rises straight up, with thick, horizontal branches arranged in whorls one above the other, and derives its name from its fruit, which bursts like the pods of cotton and discloses a similar mass of fibers, lustrous and soft as eider-down. This "wool" is used for the stuffing of cushions and mattresses and for the wadding-armor of the heavy cavalry. It has the valuable property of never becoming so compact but that it can be restored to its original volume by a short exposure to the sun. The tree is a favorite place of refuge for the negroes in time of danger. Taking their children and goods up with them, they secure an excellent natural fortress among the whorls of its limbs.

Disposition of Sewage.—Professor Henry Robinson remarks, in a paper on "Home Sanitation and Sewage Disposal," that the latter question should be regarded as involving a combination of sanitary and agricultural interests, of which the first is paramount and the latter should be disregarded when incompatible with it. Sewage is purified in passing through the soil by one or more of three processes: 1. By simple filtration or removal of the suspended matter; 2. By the precipitation and retention, in the soil, of ammonia and various organic substances previously in solution; and, 3. The oxidation of ammonia and of organic matter with the aid of living organisms. A filter-bed may be constructed so as to have a greater oxidizing power than would be possessed by ordinary soil and subsoil, by laying over a system of drain-pipes a few feet of soil obtained from the surface of a good field, care being taken to select a soil containing a considerable amount of carbonate of lime and organic matter. Such a filter-bed would be far more porous than a natural soil and subsoil, and would possess active oxidiizng functions throughout its whole depth. The presence of antiseptics interferes with the fermentation, and refuse from chemical works hinders the progress of purification. Much valuable information has been published by Drs. Lawes and Gilbert on the chemical changes that take place in the soil under varying circumstances; and Dr. Angus Smith, a rivers pollution inspector, has much to say in his last annual report on the action of air on sewage and the mode of treating sewage so as to hasten aëration; while in a previous report he has discussed the treatment of sewage by chemicals. Much information on these subjects may also be found in Mrs. Robinson's work on "Sewage Disposal" (Spon, London). Well-adapted lands have been found capable of purifying the sewage of about five hundred people per acre. The average amount disposed of in nineteen towns where broad irrigation was practiced was equivalent to the sewage of one hundred and thirty-seven people per acre.

Communicability of Disease by Food.—Except the diseases associated with tapeworm and trichinæ, the only animal diseases which there is or has been ground for regarding as transmissible to man, through ingested meat, are cattle-plague, swine-typhoid, epizoötic pleuro-pneumonia, foot-and-mouth disease, anthrax and anthracoid diseases, erysipelas, and tuberculosis. Mr. Francis Vacher, medical officer, of Birkenhead, England, having examined the evidence in respect to the communicability of these seven diseases, has announced the conclusion, in the "Sanitary Record," that only two of them—foot-and-mouth disease and anthrax—can as yet be pronounced communicable to man by infected flesh, while the communicability of the others, although it can not be positively denied, remains unproved. Cattle-plague has been supposed to be allied to various forms of human disease, but

pathologists now refuse to accept such kinship in any shape. The possibility of communicating even a mild form of disease by eating meat infected with rinderpest is not supported by any recorded instance; yet experiments whether such food would convey infection must have been tried millions of times. Instances are cited in which thousands of affected cattle were eaten during epizoöties with no bad results. Typhoid fever of swine was declared by Dr. William Budd, in 1865, to be the exact counterpart of enteric fever in man, but his conclusion has recently been found untenable after a most exhaustive research. The meat of swine ill with it is of inferior quality and diminished nutritive value, and is unfit for food in an advanced stage of the disease, but it does not carry typhoid fever. Epizootic pleuro-pneumonia taints the whole carcass of the animal affected, and communicates blood-poisoning by inoculation. Dr. Livingstone says that in South Africa the meat of animals that died of it caused malignant carbuncles in those who ate it. Dr. Letheby relates that a number of persons were made sick by eating sausages made of it in London in 1860. Dr. Gamgee mentions a prevalence of carbuncles in a convict establishment where such meat was used, which ceased when the use was discontinued; but similar meat has been used largely in Paris, the north of France, at Lille, and even in England, without visible dangerous effects. Cattle fed on parts of diseased hogs, and made to drink the food from diseased pleuræ, and animals in the Zoölogical gardens fed on the meat, suffered no ill effects. The communication of foot-and-mouth disease to man, according to Gamgee, "admits of no doubt." The disease has been transmitted by drinking the milk of animals affected and by inoculation, and there is a strong presumption that it can be conveyed by ingested meat. The existence of anthrax is determined by the presence of the *bacillus anthracis* in the blood of the subject. It is communicable by contact, for the bacilli can make their way through capillaries and large vessels, and can pierce the skin and insinuate themselves where it has not been broken. Experiment shows that the disease "can be as readily conveyed by food as in any other way. If any portion of food ingested contains live bacilli, or their spores, the consumer runs a terrible risk; and the tenacity of life of these organisms is so great we can not assign a limit to it." Several forms of disease have been referred to anthracoid causes. Whether they are anthracoidal or not can be ascertained by searching for the bacillus, which, if present, may be seen with a glass of not very high power. The communicability of erysipelas to man from infected food, though exceedingly probable, is hardly capable of direct proof. To convey it through food by inoculation only requires that it be present in the food, that the food be imperfectly cooked, and that the consumer have a minute wound in his mouth. With regard to tuberculosis, Mr. Vacher contends that direct evidence of the human form of the disease having been conveyed by ingested flesh from animals affected by bovine tuberculosis, or "pearl-disease," is wanting, although such flesh is daily sold and bought in the open market, and daily consumed by all classes. The indirect evidence "has really little bearing upon the point at issue."

Massage and Mental Hygiene as Curative Agents.—Dr. Playfair has given accounts in the "British Medical Journal" of three really wonderful recoveries from serious disease by the "Weir Mitchell" treatment, in which massage and mental hygiene are the principal agents relied upon. One patient, who had been unable to retain food in any quantities for five years, began to recover in three days, and in ten days had an enormous appetite; another, a sufferer for four years from partial paralysis, began to recover in forty-eight hours, and was well in a month; the third had been epileptic and partly paralytic for sixteen years. She began to improve in a few days, was out driving and walking in six weeks, and two months afterward went on a sea-voyage to the Cape of Good Hope, in the course of which she attended her former nurse through a fit of sickness, and from which she came back in robust health. The treatment in these cases consisted of removal of the patient from her home surroundings, and her complete isolation with her nurse; and systematic muscular movement, with the use of

the faradaic current, and vigorous feeding—to which the appetite was found ready to respond. Dr. Playfair attributes the chief value of the treatment to the fact that it appeals not to one only but to many influences of a curative character. The "Louisville Medical News," reviewing the cases, believes that the imagination is the most prominent agent in effecting the cures, and is ready to class them with "faith-cures."

Phosphorescence in Plants.—M. Crié remarks, in a communication to the French Academy of Sciences, that "it is known that the flowers of phanerogams are capable under certain circumstances of producing phosphorescent light. The phenomenon has been verified, especially of the nasturtium and the marigold. Some years ago I myself saw phosphorescent lights emitted in stormy weather from the flowers of the *Tropœlum majus*, cultivated in a garden. The emission is especially noticeable in the mushrooms The agaric of the olive, which grows in Provence, at the foot of the olive-trees, is distinguished for its white, quiet, uniform light, which resembles that of phosphorus dissolved in oil." Several other species of luminous agaric are known, but the property is not limited to that genus. The *Rhizomorpha*, or the vegetative apparatus of a considerable number of mushrooms, are also phosphorescent. These cryptogams, which are common in mines, give a light by which miners can see their hands. The luminous threads of *Rhizomorpha subterranea* are easy to perceive in the Pontpean mine, near Rennes. Luminous filaments of a rhizomorpha have been observed in branches of the elder. The *Xylaria polymorpha*, collected from old stalks in a garden, has been seen to emit a feeble white glow, like that of phosphorus in the air.

Professor Virchow on Humboldt.—A monument to William and Alexander von Humboldt was unveiled at the University of Berlin on the 28th of May. Professor Virchow delivered an address on the occasion, in which he spoke in the highest terms of the character and value of the work of the two brothers. "We older men," he said, "who have learned personally from Alexander von Humboldt, and have in part worked with him, feel our strength renewed when we see how the memory of the time of the new birth of our people is perpetuated to posterity in the many monuments of our city. One who walks through our streets will discover that Goethe and Schiller, Stein and the Humboldts, Blücher and Schwarnhorst, did not casually live side by side, but that a recognizable connection prevailed in their development, and wove their works together to a single end. Every German will look with pride upon the men who have risen from out of the midst of the people to the highest places of honor, because they wakened and unfettered the noblest forces of the nation. Especially could our academic youth, who have these models before their eyes every day, learn from the history of such men what recompense genuine work can gain. Humboldt, who completed the 'Cosmos' in extreme age, and who wrote in the last year of his life, 'For thirty years I have had no rest, except at night,' was at one time a sickly lad, whose teacher in the first years of his childhood doubted whether he would ever manifest any more than the most ordinary mental faculties. He, whose youth fell in an age when hardly anything but speculative wisdom, poetic invention and dogmatic tradition were held in honor, had, in his incessant struggles in nearly all the domains of natural science, brought into avail that stronger objective method of thought, comprehensive in its grasp, which has since become the pride and the common estate of the learned of modern times. When he at last, like the world-sages of antiquity, united in himself all the knowledge of his time on natural subjects, and with it the comprehension of its historic growth, it was not the knowledge of a compiler that he displayed, but the fruit of long special work in each single field. He served in the ranks as a national economist and as a miner, as an astronomer and as a physicist, as a chemist and as a geologist, as an anatomist and as an experimenter in vegetable and animal physiology. He was the first scientific traveler who independently studied all the natural and political conditions of the countries visited by himself. Political and physical geography, the study of terrestrial magnetism, plant-geography, and ethnography, grew under his care to be

independent branches of science. His example was operative everywhere, as that of one of the most self-active masters in the shop. He has been called vain and selfish; but his vanity was never so strong as to overcome his love of the truth, and his selfishness never prevented his fostering all budding talent and joyfully greeting every advance in knowledge. He refused high positions, so strongly was his innate inclination turned toward the advancement of knowledge. Long after he had become one of the recognized teachers of mankind, he did not cease to learn; but he learned as an investigator learns; and, even as against the most adept, he never gave up the right of testing by his own proofs. It was thus that we learned to know Alexander von Humboldt. His frame was bent under the burden of years and labors, but his spirit was high-set, and his eyes still looked clearly into the world. He was valuable to us as one who had the highest knowledge, and was at the same time perfectly discreet, as a high-priest of truth and humanity, as a true friend of civic freedom. Feeling this, we have erected his monument. May it be a symbol to many generations of the efforts of this age!"

The Physicians' Part in Evolution.—The "Lancet" has been asked, "Why, if it be natural and expedient that only the 'fittest' should survive, are we [the medical men] as a profession chiefly interested in prolonging the lives of those who have been rendered unfit by disease or accident?" It admits that, "if it were really a fact that the whole business of our lives, the work to which we devote the best of our strength and intelligence, had for its object to antagonize the natural course of progress as regards the race, although compassion for the individual might impel us to continue the effort, it would certainly damp the ardor of our enterprise to reflect that those we are striving to keep alive ought in the interests of posterity to be left to die." The seeming paradox the "Lancet" reasons is, however, in truth a fallacy. It is founded on an imperfect view of the inter-relations of the world. "Survival of the fittest" is not the same thing in its result as "adaptation to circumstances." Development, through and by the environment, is the method of Nature, but this does not necessitate that man should be the creature of circumstances. The environment is not a constantly progressive agency of development. It is itself subject to the law of survival. It can not, therefore, be absolutely or abstractly true that the fittest for the existing conditions of life in any particular place or epoch ought to survive. It is wholly out of our power to determine whether the particular type of development which seems to be making its way in the world and asserting its superiority by survival, and is for a time regarded as normal, is the best type, or that which is destined to endure and be perfected. The surroundings of life are progressively changing as well as the subjects of life. There is a perpetual struggle for supremacy between the two, and it is always an open question whether the resultant of this struggle will be found to embody a greater or less modification of subject or circumstance. "Our duty as practitioners of the art of healing does not relate to the surroundings, except in so far as these may be regarded a tributary to the central fact of life. If we can modify the conditions and circumstances of existence so as to render life easier, it is in our day's work to do this, and to do it heartily; but the commission we hold is to prolong life, and to fight against all that tends to destroy or weaken it. In so doing, we are not merely benefiting the individual, but the race, because, so far as we know, man is the highest created organism, and as such he is destined to dominate circumstances. For us 'man' takes the form of *men*. The race may be higher than the individual, but it is with the latter we have to deal."

Ancient and Modern Egyptian Schools and Libraries.—Mr. Reginald Stuart Poole has attempted to trace an historical connection between the ancient Egyptian schools and library at Heliopolis and the Alexandrian Library and University, and even the present Moslem University at Cairo. The sources of information respecting the ancient schools are chiefly old hieratic papyri, some of which were actually exercise-books of students, and they tell us of temples attached to colleges in various large towns.

At Heliopolis, where were the most famous schools, religion, law, mathematics, medicine, and language were taught. Primary schools were provided for all classes; and libraries were attached to the temples. The old methods were adopted in the institutions founded at Alexandria by the Ptolemies, but, as these were intended for a mixed population of Egyptians, Greeks, and Hebrews, law and religion were excluded, to avoid controversy. Learned men were maintained by the state to prosecute research, and a botanical garden and a menagerie were added. The first Alexandrian Library was burned when Julius Cæsar captured the place. The second disappeared at the time of the Arabian conquest. The university was restored by one of the caliphs two centuries after the conquest. The great University of Cairo, which has five thousand students, and practically includes all the Alexandrian faculties except medicine, was founded by a Greek officer of the Fatimite caliphate, A. D. 969–970.

The Jackal, the Fox-Fables, and the Dog-Star.—Herr O. Keller, in a paper on "The Jackal in Antiquity," urges that the Western nations, who had foxes but no jackals, borrowed the traits ascribed to jackals, in Oriental fables, with the fables, and transferred them to their foxes. Thus the Grecian foxes were endowed with the attributes of two animals, and the most curious fox-fables of Æsop are in their origin Indian jackal-fables. Some of Æsop's fables represent the fox as the follower and servant of the lion, which he is not known to be in any sense. The jackal, however, is in the habit of following the lion at a respectful distance, and lives on what he can pick up from the deserted repasts of the king of beasts. This trait was observed by the ancient Indians, and it was a natural result of the observation that their vivid imaginations, discovering royal prerogatives in the lion, should endow his follower with the qualities of a minister and counselor, and make him to assist his majesty by using in his behalf the qualities of slyness and cunning in which the royal beast was deficient. The Greeks substituted foxes for jackals because they knew nothing about them, and their foxes came nearer than any other animal to answering the descriptions of them. The transfer was made easier by the gradual development of the fables from simple nature-stories into moral lessons, in the course of which absolute truth to nature grew less essential, and the representation of abstract qualities under purely conventional masks became more prominent. The incongruous association by the Greeks of the supposed evil influences of Sirius with the harmless dog are susceptible of a similar explanation. The Chinese, however, who also attributed evil qualities to the dog-star, called it the jackal-star, and appropriately; for as the heat and drought of which it is the forerunner are destructive to the crops, so likewise are the jackals, which make their home in the fields, and are constantly running through them in gangs, destroying myriads of plants, in search of their food. To the Egyptians, Sirius was also the jackal-star, but foreboded good, for it appeared just before the time of the inundation. The Mesopotamians also recognized in it a forerunner of beneficent inundations, and gave it the name of the dog, an animal which they held in high esteem. The Greeks borrowed the Mesopotamian name, and kept the Chinese idea, which harmonized well with the character of their own dog-days. The origin of the dog-star has been associated by some other writers with the idea that Sirius, the chief of the stars, was the shepherd-dog to the host of the heavenly sheep, represented by the other stars.

Deforestization and Floods in China.—The country of the lower Yangtse-Kiang in China suffered terribly from floods last July and August. Dr. Macgowan has taken advantage of a trip up the river, for the distribution of relief to sufferers, to make inquiry whether any connection existed between the inundations and the removal of the forests. China, old as it is, is not so old but that the process of denuding the land of trees may be distinctly traced. The treeless aspect of the hills of the lower Yangtse now attracts attention from every voyager; yet no mention is made of their barren condition by Ellis or Davis in their narratives of Lord Amherst's embassy in 1816, but wooded hills are alluded to; from which it would seem that the deforestization

is recent. The inundations by which the lower country is frequently submerged come from the Poyang Lake, concerning which very little is actually known, either as regards its floods or its rain-falls. It is known only that there is evidence of a great thinning out of forests on the mountains of Southern Kiangsi, although it has not been carried to the extent that Che-kiang has experienced, where arboriculture is systematically pursued to meet demands for timber. In the hills near the coast, which are stripped annually of grass, ferns, and bushes for fuel, the process of the gradual denudation of the hills is distinctly observable. The soil is never carpeted by leaves; no humus forms; rain, instead of slowly percolating as through a sponge, rushes in water-courses as from the roof of a house into gutters, speedily filling them, and carrying with it soil, which tends to increase the evil. In this way the lakes are destined to become desiccated much sooner than they otherwise would be. It is because of the occasional sudden rush of waters that freshets are always attributed to the spouting of *chias*—subterranean monsters. Several of those are reported as being concerned in the late floods. While there is conclusive evidence that there has been in recent times a great destruction of forests, it is not clear that floods have proportionately increased in number or rapidity; it is, however, what might be expected, and it is what is affirmed by natives when accosted on the subject. Deforestization has had one favorable effect in the south of China, in reducing the ravages of jungle malaria, which recedes with the advance of agriculture.

New Serviceable Metallic Alloys.—Three new metallic alloys have been recently introduced, which seem fitted to serve as substitutes for bronze, imitation gold, and imitation silver. Delta, a bronze made by Mr. Alexander Dick, of London, is a compound of iron, zinc, and copper, the proportions of the ingredients being varied according to the color it is sought to obtain, and has the advantages of extraordinary tenacity and flexibility. It can be beaten, and forged, and drawn when cold, takes a perfect polish, and, exposed to the air, is less liable to tarnish than brass. Aphthite is a "gold," which does not change, and is composed of eight hundred parts of copper, twenty-five of platinum, and ten of tungsten. Its shade of color may be changed by varying the proportions of its constituent metals. Sideraphthite is a similar "silver" metal, and is composed of sixty-five parts of iron, twenty-three of nickel, four of tungsten, five of aluminum, and five of copper. These alloys are capable of resisting hydrosulphuric acid, are not attacked by organic acids, and are only slightly attacked by inorganic acids.

NOTES.

Mr. F. H. King, State Geologist, estimates the bird population of Wisconsin at sixty-six per square mile, or 3,565,000 for the State. Each bird is assumed to eat fifty insects a day, or 6,000 for the summer. Hence all the birds will consume 21,384,000,000 insects a year. "Add to this amount the work which these birds do in their Southern homes, and we have a low estimate of the influence they exert over insect life."

An improvement on the Bunsen cell, by M. Azapis, consists in substituting for the acidulated water a solution of about fifteen per cent of cyanide of potassium, caustic potash, common salt, or sal-ammoniac. The intensity in the new form is as great as in Bunsen's, and the advantages are, greater constancy, less waste of zinc, and very little smell; further, the zinc does not need amalgamating.

H. T. Cresson has obtained, from Aztec clay flageolets, the fourth, seventh, and octave tones of the diatonic scale, and the additional sounds or semitones which constitute the chromatic scale. These notes are produced by means of the four finger-holes and by stopping or half stopping the bell of the instrument. The flageolets are pitched in different keys, and, if the Aztecs knew the full capacity of their instruments, their music must have far surpassed that of other uncivilized peoples.

Professor Archibald Geikie remarks, concerning the future history of the Grand Cañon of the Colorado, that it has still about a thousand feet to remove from the bottom of its channel before its slope will become so slight that its erosive power will nearly cease, and that it is conceivable that, should no geological revolution occur in the region, the cañon may still be deepened to that amount. There are indications, however, that a limit may be set to the possible depth of the chasm. As in the "creep" of a coal-mine, the bottom of the cañon, relieved from

the weight of the overlying column of rock, may be forced upward by the pressure of the walls on either side. In that case, the channel might rise as fast as the river cut it down, so long as nothing occurred at the surface materially to diminish the height of the walls.

SHAD, which were first introduced there seven years ago, are now to be found all along the coast of California, and are rapidly making their way northward. The "run" in the Columbia River this year was described as wonderful, and the fish were a drug in the market. In California they have not yet come into popular use, owing partly to the fact that the closed season established by law is just when they are in the rivers. The order of their running in that State is different from that in the Atlantic States. They appear in San Francisco Bay in October, and leave it in May; while for other parts of the coast their run begins later as the latitude increases.

THE Convocation of the University of Oxford has voted £10,000 for building a laboratory, working-rooms, and lecture-room for the Waynflete Professor of Physiology, DR. Burdon-Sanderson. The grant was opposed by some of the members of the board, on the ground of their objections to vivisection, but was carried by a majority of three in a house of one hundred and ninety-three members.

A CURIOUS application is made of liquid carbonic acid at Krupp's foundry, in Essen, Prussia. The cannon made there are bound with rings, which are put on in nearly the same manner as the tires are put on wagon-wheels; that is, they are heated very hot, and driven on over the cold cannon, so that when they cool they hold it very tight. Sometimes it is desirable to get the rings off. This is done by freezing the cannon by means of the evaporation of liquid carbonic acid, when they contract and leave the rings loose. The French journal, "La Production," calls the operation "a formidably neat one, and of really Herculean elegance."

DR. CHAILLÉ, of New Orleans, has made a study of the influence of the inundations to which Louisiana is subject upon health. He finds that they do not cause inevitably or generally any notable increase of malaria or of other disease, and that they certainly do not usually either cause or promote epidemics. Their direct influence is, therefore, not usually to be dreaded. They may, however, in certain soils and conditions be charged with after-influences of a deleterious character, as when the soil is loaded with malaria, or deposits of filth have accumulated upon it. Such soils and deposits, festering in the sun after the floods have retired, may develop very serious evils.

M. PERRIER describes an Asteria (*Caulaster pedunculatus*) that was dredged up in the Travailleur expedition, which appears to furnish a link between the ancient crinoids and the modern star-fishes. It is a star-fish, having on its back a peduncle quite similar to that of the crinoids, which is surrounded by a system of plates resembling those that composed the "calyx" of those animals. The peduncle probably served as a support for the young star-fish while it was temporarily fixed, and was probably destined to disappear by the progress of development; but this view needs to be confirmed by further examination.

M. MARCHAND, having repeated with water some of the experiments which Professor Tyndall has performed on the air, declares that there is no really clear water in existence. Filling a bottle with the liquid, he covered it with black paper, and pierced in the paper two holes at opposite points. Looking through the holes at the light, the dust-particles floating in the water were made plainly visible. They were transparent, only two millimetres in diameter, and elastic enough to pass through the closest filters.

MR. JOSEPH WILLCOX remarked at a recent meeting of the Academy of Sciences of Philadelphia on the scarcity of springs and running streams in Canada. Where streams exist, they are almost exclusively the outlets of lakes. He ascribes the feature to the fact that the ancient glaciers swept away a large proportion of the soil of the country, leaving the underlying rocks usually near the surface, and in many cases visible above the ground. Thus the material is deficient which, in countries where springs and streams abound, soaks up the rain and melting snow, and afterward gives out a perennial flow of water.

"LA NATURE" records the death, at Catania, Sicily, in the thirty-third year of his age, of M. Tedeschi di Ercole, an investigator of earthquakes and volcanic and other physical phenomena, and a frequent contributor to it on subjects relating to them.

MR. JACOB ENNIS specifies as two great works to be done on our sidereal system—to ascertain what way the great ring of the milky way revolves, and to discover in what direction to look for the center of the system and estimate its distance. The tasks are to be wrought out gradually by observing and measuring the proper motions of the stars, and composing a map by the aid of which the relations of those motions to each other and to the common center may be determined. The details of his method are explained in a pamphlet of twelve pages published by Judd & Detweiler, Washington, D. C.

ALEXANDER VON HUMBOLDT.